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WEIGHING IN RADIO STATIONS

SEE PAGE 1122

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The Vacuum Tube of Today

remains the most sensitive device in the radio world. During the past year it has reached new heights of performance in making A C reception possible. Cunningham Radio Tubes have pioneered and blazed the way for each progressive step and maintained their high standard of quality from the earliest days of the industry.

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JOINING the Radio Association enables you to cash in on Radio *now!* Follow its success-proven plans and you can earn $3 an hour, in your spare time, from the very first. Over $600,000,000 is being spent yearly for sets, supplies, service. You can get your share of this business and, at the same time, fit yourself for the big-pay opportunities in Radio.

Founded on a New Idea

Members of the Association do not wait for months before they make money out of Radio. Without quitting their jobs, our members are earning $25 to $75 a week spare time by building "tailored" radio sets, serving as "radio doctors," selling ready built sets and accessories, or following one of the many profit-making plans of the Association.

Earned $500 in Spare Hours

Hundreds earn $3 an hour as "radio doctors." Lyle Follick, Lansing, Mich., has already made $500 in spare time. Werner Eichler, Rochester, N. Y., is earning $50 a week for spare time. F. J. Buckley, Sedalia, Mo., is earning as much in spare time as he receives from his employer.

We will start you in business. Our cooperative plan gives the ambitious man his opportunity to establish himself. Many have followed this plan and established radio stores. Membership in the Association has increased the salaries of many. Scores are now connected with big radio organizations. Others have prosperous stores.

A year ago Claude De Grave knew nothing about Radio. Today he is on the staff of a famous radio manufacturer and an associate member of the Institute of Radio Engineers. He attributes his success to joining the Association. His income now is 350% more than when he joined.

What a Membership Can Do for You

1—Enable you to earn $3 an hour upwards in your spare time.

2—Train you to install, repair and build all kinds of sets.

3—Start you in business without capital, or finance an invention.

4—Train you for the $3,000 to $10,000 big-pay radio positions.

5—Help secure a better position at bigger pay for you.

6—Give you the backing of the Radio Association.

A MEMBERSHIP NEED NOT COST YOU A SINGLE CENT

Doubled Income in Six Months

"I attribute my success entirely to the Radio Association," writes W. E. Thon, Chicago, who was clerk in a hardware store before joining. We helped him secure the managership of a large store at a 220% increased salary.

"In 1922 I was a clerk," writes K. O. Benzing, McGregor, Ia., "when I enrolled. Since then I have built hundreds of sets—from 1-tube Regenerative to Superheterodynes. I am now operating my own store and my income is 200% greater than when I joined the Association. My entire success is due to the splendid help it gave."

Easiest Way Into Radio

If ambitious to become a Radio Engineer, to fit yourself for the $3,000 to $10,000 opportunities in Radio, join the Association. It gives you a comprehensive, practical and theoretical training and the benefit of our Employment Service. You earn while you learn. You have the privilege of buying radio supplies at wholesale. You have the Association behind you in carrying out your ambitions.

ACT NOW—if you wish Special Membership Plan

To a limited number of ambitious men, we will give Special Memberships that may not—need not—cost you a cent. To secure one, write today. We will send you details and also our book, "Your Opportunity in the Radio Industry." It will open your eyes to the money-making possibilities of Radio. Write today.

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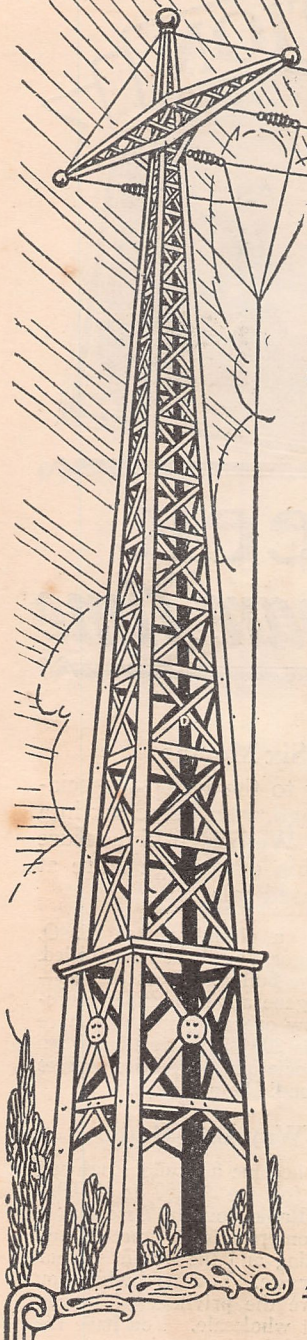

RADIO NEWS

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THE "R.F. BOOSTER UNIT"
By David Grimes

This well-known radio engineer has designed a novel instrument for use with any radio receiver to increase range and selectivity. It can be plugged in or out as receiving conditions vary.

COMING—A PROGRAM POOL?
By Charles Magee Adams

There remains now hardly an unsolved problem in the technique of radio broadcasting except this little one—*who shall bear the expense?* Mr. Adams' comments will interest every listener.

HOW BROADCASTING IS ACCOMPLISHED
By G. C. B. Rowe

The workings of the radio receiver are well known to most readers, and the broadcast studio shows little that is mysterious. This article explains in simple language the laborious processes that lie between.

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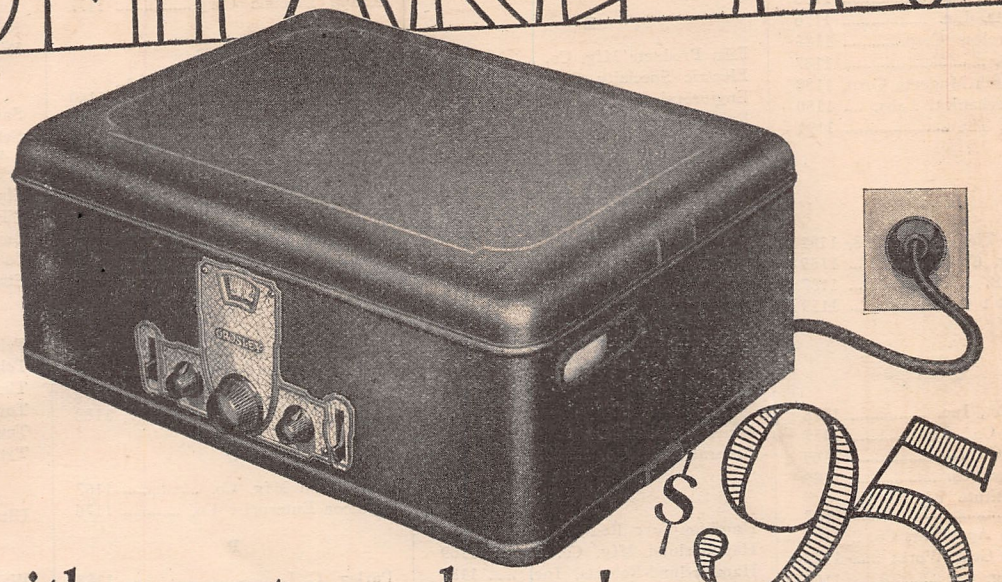

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7. Volume control that will reduce heavy local reception to a whisper without detuning and without distortion.	Yes		
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12. Quantity production price of less than $100.	Yes		

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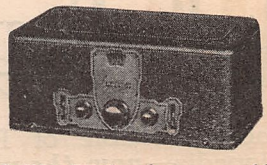

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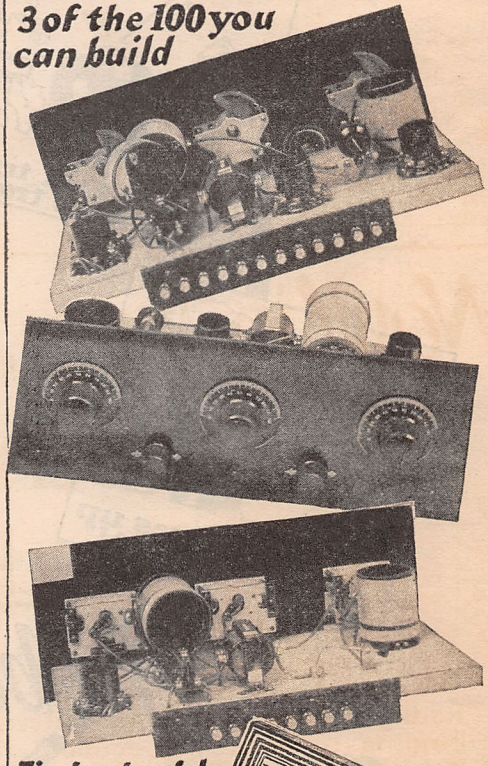

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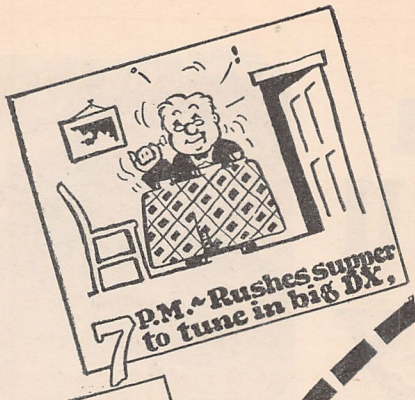

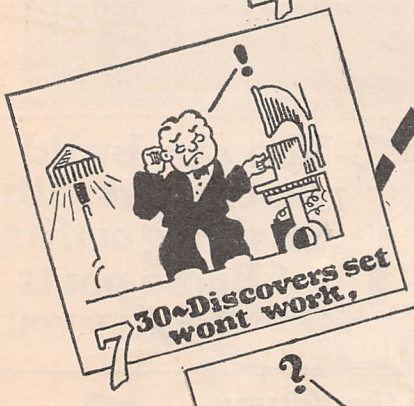

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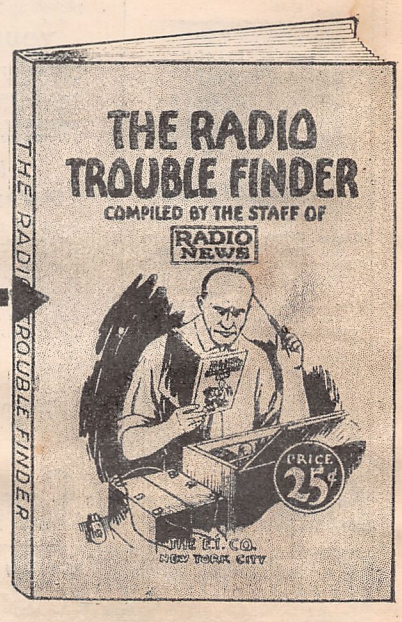

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A.B., A.M., LL.D., Ph.D.

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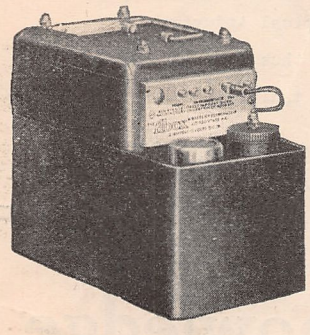

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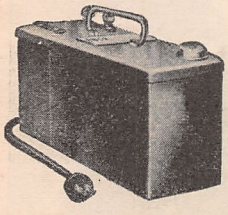

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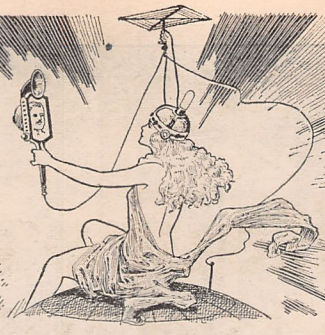
Radio News



Hugo Gernsback Editor & Publisher

Editorial and General Offices, 230 Fifth Avenue, New York

Vol. 9 APRIL, 1928 No. 10

Radio News' New Policy

By Hugo Gernsback

WHEN the first number of RADIO NEWS was launched in July, 1919, I said as follows: "And here is the platform upon which RADIO NEWS stands. I pledge myself to a strict adherence to every plank:

"First: Only Radio—100% of it—nothing else.

"Second: An organ for and by the amateur. The amateur's likes and wants will always come first in this magazine.

"Third: Absolute Independence. RADIO NEWS has only one Boss—its readers. This magazine is not, nor will it ever be, affiliated with any stifling, commercial radio interests whatsoever.

"Fourth: Truth—first, last and always. When you see it in RADIO NEWS you may be sure that it is so. Not being affiliated with commercial radio interests, this magazine will have no reason to suppress important articles, discoveries, etc.

"Fifth: RADIO NEWS is and will be the sworn enemy of all adverse and unfair radio legislation.

"Sixth: Instructive first and last. Up-to-date scientific articles for your instruction will always have first place in RADIO NEWS. We shall publish purely scientific articles every month, articles that on account of their length are often crowded out of other publications.

Seventh: First in print with the news. You will find all important radio news in this magazine from one to three months ahead of all other publications—always."

That was before the days of broadcasting and when radio fans still were "bugs" and transmitting amateurs; but, as a whole, the situation has not changed, nor has the platform of RADIO NEWS changed at all.

On the other hand, in an art that grows as rapidly as radio, changes occur overnight and it is necessary for any organization, whether a publisher or a factory, to conform itself to those changes. For instance, in 1919 there were some 10,000 amateurs, and not one of the so-called "broadcast fans," because there was yet no broadcasting.

> *THE articles in* RADIO NEWS *are in my opinion "inspired" by your advertisers and of little value to your subscribers. Most radio magazines are similarly unreliable. Why don't you occasionally publish something worth while? Your readers are not all morons. When and if you publish a radio magazine for the benefit of your subscribers rather than your advertisers, I will again subscribe. Who wants a catalog?*
>
> *Yours very truly,*
>
> FRANK H. CHASE, M.D.,
> 2362 W. 21st Street,
> Los Angeles, Calif.

When broadcasting came along, it meant an important change, not only to the amateurs and fans, but to the radio industry as a whole. Changes came about with lightning rapidity, yet RADIO NEWS adapted itself to them to give the maximum service, not only to its readers, but to the whole industry as well.

RADIO NEWS has always been the largest of all the radio publications in point of circulation, and otherwise; and as such, it has a tremendous obligation to, not only the radio art itself, but all interests connected with it—readers, fans, amateurs or the industry. As the strongest and most representative of all the radio publications, RADIO NEWS has always valiantly striven to be of service to all concerned.

From 1919 to 1926, it was the policy of RADIO NEWS never to mention the name of any product within its text pages. RADIO NEWS has always maintained that the proper place to advertise a product is in the advertising pages rather than in the text pages. However, toward the end of 1926, it was seen that the radio parts industry was heading rapidly downward; and it became necessary, as it had been necessary before during similar changes, to recognize the altered conditions. During the radio boom, there were some 30,000 dealers in this country handling radio parts; at the end of 1926, this number had shrunk to no more than 2,500.

RADIO NEWS then was confronted with a most perplexing and difficult problem. Its readers always had been amateurs, fans, and constructors who built their own, as well as custom builders. For that reason, many new and novel circuits were published in RADIO NEWS, such as the Tropadyne, Ultradyne, Strobodyne, Interflex, and many others of national and international importance. But RADIO NEWS also recognized the obligation to see to it that the man who wanted to build his own *could* do so. This, of course, is elementary; if you write a book on bridge, and it becomes impossible for the readers of that book to buy playing cards, the book is useless. If you publish a golf magazine and it is impossible for the readers to buy golf clubs and golf balls anywhere in the country, you will not stay in business long; neither will a publication advance the golf industry if it does not help create markets for the golf manufacturers. All this is self-evident; RADIO NEWS is in a position not at all different.

Since the radio parts dealers declined from 30,000 to 2,500 in a few years, if this decline were allowed to go on, it would soon be impossible to print RADIO NEWS; because the manufacturers of the radio material would have no longer an outlet, and the radio constructors and home builders would find it impossible to buy materials. It is true that a builder can wind his own coils, and drill his own panels; but certain articles, such as switches, condensers, tubes, sockets and others, he can never hope to make, and must buy.

Against its better judgment, RADIO NEWS, during 1927, endeavored to better trade conditions by publishing manufacturers' names and giving manufacturers' specifications in its text pages; because it seemed that it would thus be made easier for the reader to buy suitable material than if no names were given and he had to guess them. In doing so, RADIO NEWS honestly believed that not only would it serve its readers, as it had always done, but the radio trade as well.

It is, however, admitted now that this policy was wrong and, beginning with this issue, we revert to our former custom of not mentioning any manufacturers' names or trademarks of parts and circuits of any kind in the text pages of RADIO NEWS. In that respect, we go back to our former practice of the years previous to 1927.

It was soon found that readers of RADIO NEWS became suspicious and thought that advertisers were controlling the text pages; and it must be admitted that that is the way it often looked to the outsider.

At no time, however, did RADIO NEWS reap any material benefit from specifying manufacturers' names and materials. If any proof is wanted, the constant advertising shrinkage of RADIO NEWS during 1927 is glowing testimony of this fact. At no time did the trade (particularly the parts manufacturers) really support RADIO NEWS, in spite of its publishing their names and specifications quite freely. An intolerable situation was reached, since it was impossible to mention in one issue the products of all manufacturers and, wherever one friend was made among the parts manufacturers, many enemies were made.

But the worst part was that many readers became dissatisfied with seeing so many circuits, which to them seemed sponsored by kit manufacturers; and some refused to read RADIO NEWS any longer. Letters like that printed here became numerous as time went on.

Yet it must be evident to every fair-minded reader that the publishers did not reap a harvest from the manufacturers. Quite to the contrary, the publishers lost heavily during the experiment. So, beginning with this issue, we revert to our former rule, as follows:

RADIO NEWS will no longer mention any radio material by a trademarked name; no manufacturers' names will be printed in an article on construction. Circuits originated by parts and kit manufacturers will not be given the manufacturers' names; if a worth-while circuit comes along, RADIO NEWS will bestow on it its own proper name.

An important new policy will be initiated, under which RADIO NEWS will *give away free* the blueprints that, for over two years, have been sold for from $1.00 to $2.00. These blueprints with full specifications will, however, contain the names of the parts which were used by the constructor who designed the actual assembly. On the blueprint will be mentioned the trade name and the manufacturers' names, so that the constructor who wishes to build the circuit can do so with the least amount of difficulty. But this information, as we have said, will *not* be published in the text pages of RADIO NEWS.

In all other respects RADIO NEWS' policy will be the same, except that hereafter only one featured constructional article will be published each month. This does not exclude the publication of constructional articles for beginners, describing circuits in which not more than three tubes are used. There will, therefore, be not more than two constructional articles describing receivers in RADIO NEWS monthly, although there may be an occasional description of a power pack, amplifier, etc.

It is hoped that, in making these changes, RADIO NEWS will continue to serve, as before, the entire radio industry; but, first and always, it should be understood that RADIO NEWS is published primarily for its readers. That has always been its policy, and always will.

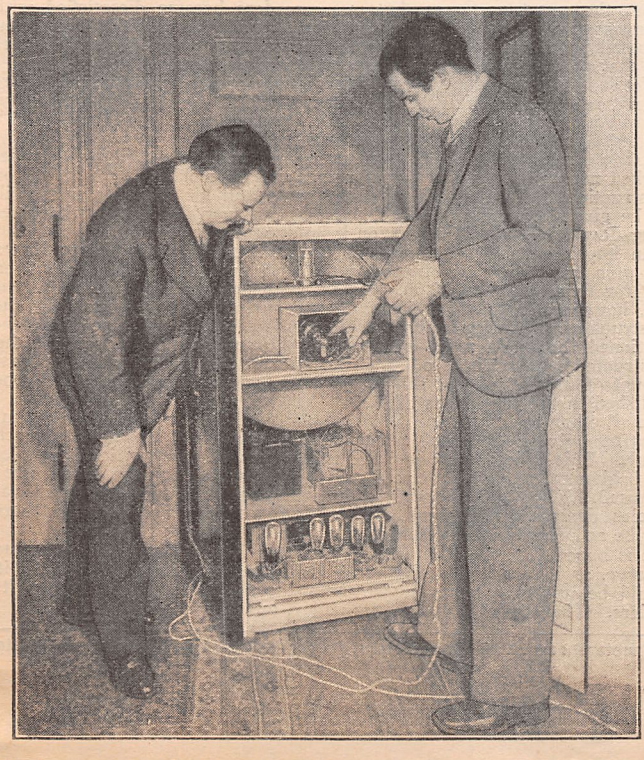
Mr. Hugo Gernsback speaks every Tuesday at 9.30 P. M. from Stations WRNY (326 meters) and 2XAL (30.90 meters) on various radio and scientific subjects.

Television Comes to the Home

by G. C. B. Rowe

BACK a few years—and not so very many at that—it was said that but one human faculty could jump in a fraction of a second from one end of the earth to the other—the imagination. Up to a comparatively short time ago this was true; but, with the advent of radio broadcasting as it is known today, it became possible practically to annihilate the limitations of space, with respect to sound. Is it now considered marvelous when a singer is heard, three thousand miles distant? Indeed, no; the listeners take it as a matter of course, as they do the other wonderful inventions in daily use.

But until very recently it was still up to the overworked imagination to picture the appearance of the performer who was broadcasting. In some cases this may have been for the best; as the imagination is a wonderful artist, and produces often beauty where beauty is not. But, for better or for worse, thanks to the further developments made by Dr. E. F. W. Alexanderson in the art of television, what actually occurs in the broadcast studio can now be seen by the radio audience.



At the top of the page, tuning the television receiver: the image is seen through the small square opening on a level with the operator's eyes. Notice the broadcast receiver and loud speaker. At the left, Fig. D. shows the rear of the receiver: one man is pointing out the universal motor, which drives the scanning disc. Above the motor is the Moore neon lamp. On the lower shelves are batteries and the amplifier and rectifier tubes. Dr. E. F. W. Alexanderson is seen at the left in each illustration.

Although the picture as seen in the television receiver appears no more than three inches square, and there are instants when it is obliterated by static or some other interference, the remarkable part of the story is that the device worked at all. Every so often, during the last few years, enthusiastic articles have appeared, telling how television is rapidly becoming a reality instead of an engineer's dream. But these fulfillments of dreams were in laboratories; now television has been carried to the home.

TELEVISION DEMONSTRATION

In one corner of a vast room in the General Electric Company's research laboratory at Schenectady, N. Y., a few days ago, were set up an arc light, a rapidly-revolving metal disc, four photoelectric cells in a frame, and several boxes. Just around a corner a group of men were gathered in a room totally dark, save for two squares of pinkish light about three inches square. These two squares of light were the cynosure of all eyes; these pinkish squares were what many of the men in that room had travelled hundreds of miles to see; for they were the proof that television in the home is no longer a dream, but an actual fact.

A young woman was seated before the bank of photoelectric cells, with narrow bands of light and shadow playing across her features. She smiled, frowned, rolled her eyes, and smoked a cigarette—and all these actions were instantly and faithfully pictured in the little squares of pinkish light in the adjoining dark room. At the same time, the conversation which she kept up with one of the operators came into the dark room through a loud speaker. Then

her place was taken by a young man with a ukelele and, although the instrument was invisible (being below the line of vision of the transmitting apparatus), his voice and the music came from the loud speaker as his face appeared in the magic squares.

The question will present itself naturally to the reader's mind: *"How well* did these faces come over the air?" It was possible to see every detail in the features, the individual teeth, for example; when the eyes were rolled, one could follow with ease the movement of the pupils. In short, the transmission of faces by radio can be compared in quality to moving pictures in their earliest days.

In three homes in different sections of Schenectady, similar television receivers had been installed to show that reception in the home is possible and practicable. A short antenna was employed to pick up the 37.8-meter wave on which the television impulses were broadcast. The results obtained in the homes were of the same excellence as those demonstrated in the laboratory.

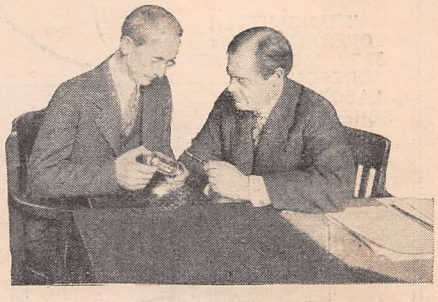
THE ELECTRIC EYE

The transmitting apparatus for broadcasting television is not very complicated, as can be seen from Figs. A and B, which show the pick-up. In the left foreground of Fig. A is a powerful arc light, the rays of which are broken up by the spirally-arranged holes in the disc, which is rotating at the rate of eighteen revolutions per second, being driven by a small motor. The light rays are concentrated and focused on the face of the girl by means of the lens held in the square wooden support. See Fig. B.

After the rays of light from the arc have been broken up by the revolving disc and focused on the face of the subject (where they appear to the camera as a series of light and dark lines; see Fig. C), they are reflected from the surface of the face to the four photoelectric cells in the thick, square frame of galvanized iron. These possess the property of changing light energy into electric energy. (These cells were described on page 640 of the December, 1927, issue of Radio News; previous television experiments will be found described in the June, 1927, issue.) The output of these cells, after being amplified, modulates the carrier wave of the 37.8-meter transmitter, the antenna of which is located on the roof of the research laboratory. In Fig. B may also be seen at the right of the table the condenser microphone for picking up the voice, which was simultaneously broadcast on WGY's regular wave of 379.5 meters. A very short wavelength was chosen for broadcasting these "pictures" because a channel 40 kilocycles wide is needed; this is because of the depth of modulation necessitated by the great range of differences in shading, which must be reproduced in the transmission of vision.

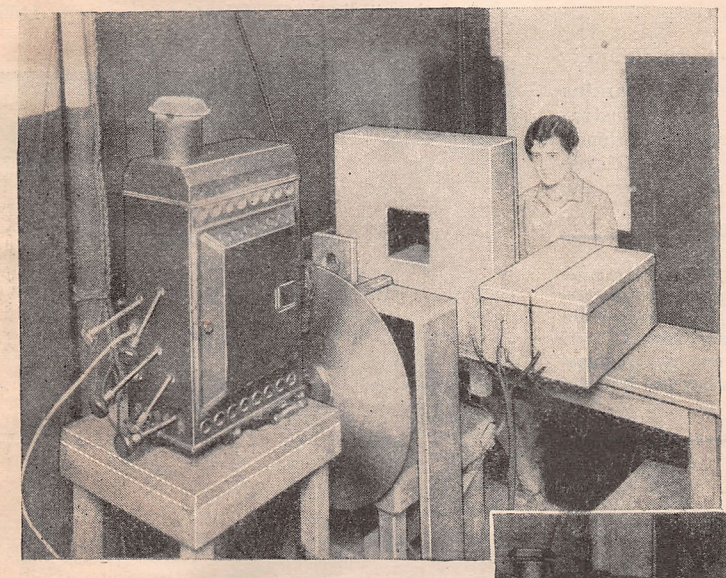
THE ELECTRIC PAINTBRUSH

The average radio enthusiast is most likely much more interested in the apparatus for reception than in that just described. Compared with the television receivers that have been described in this magazine previously, the latest one is simplicity itself. In place of the loud speaker, a Moore neon tube is connected in the output of a short-wave receiver of the regenerative type. The most interesting property of the neon lamp, which was invented by D. McFarlan Moore (as related in Mr. Moore's biography, "Thirty years in the Dark Room," which appeared in Radio News, from December, 1925, to May, 1926), is that it responds to the changes in intensities of the current and causes fluctuations in the intensity of the emitted light; just as the diaphragm of a loud speaker produces pulsations in the air in response to alternating-current impulses. It is said that this lamp will go on and off in a millionth of a second; so that in its use there is none of the "time lag," which is the greatest problem those working in television have had to meet.



D. McFarlan Moore (left) and E. F. W. Alexanderson discussing the neon lamp used in the television receiver

The plate of the Moore tube, on which the image is built up, is about 1½ inches long and 1 inch wide. The scanning disc, which can be seen in front of the lamp in the rear view of the apparatus (Fig. D), is of the same size as that used in the transmitter, 24 inches in diameter. The 48 holes (which have a diameter of 35 mils each—or about 1/30-inch) trace successive lines on the picture, literally "painting" it in one revolution. The disc is turned by a standard "universal" motor; which is to say that it can be operated from either direct or alternating current. The speed of this motor and, therefore, of the disc, is controlled by a push-button. In order to enlarge the image as much as possible, a magnifying lens is placed between the scanning disc and the observer's eye; thus bringing the image up to 3 inches square.



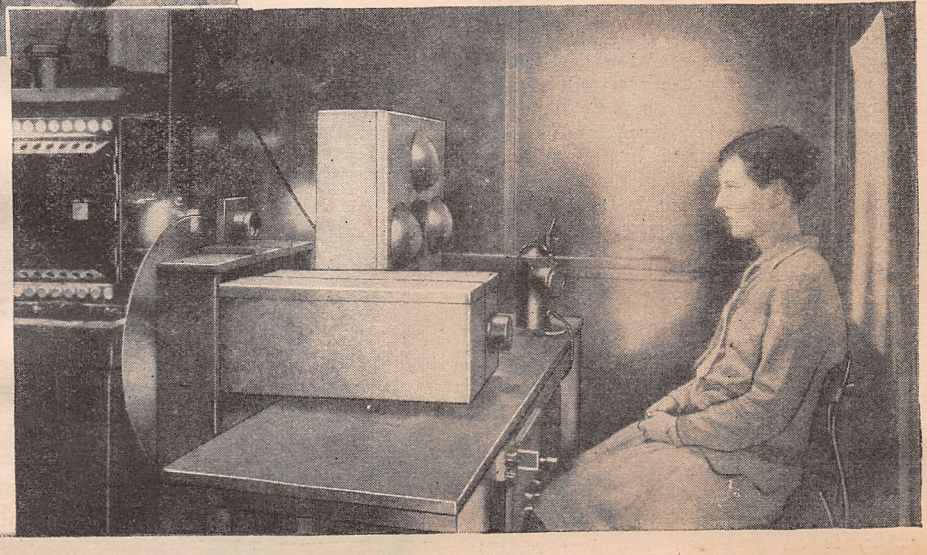
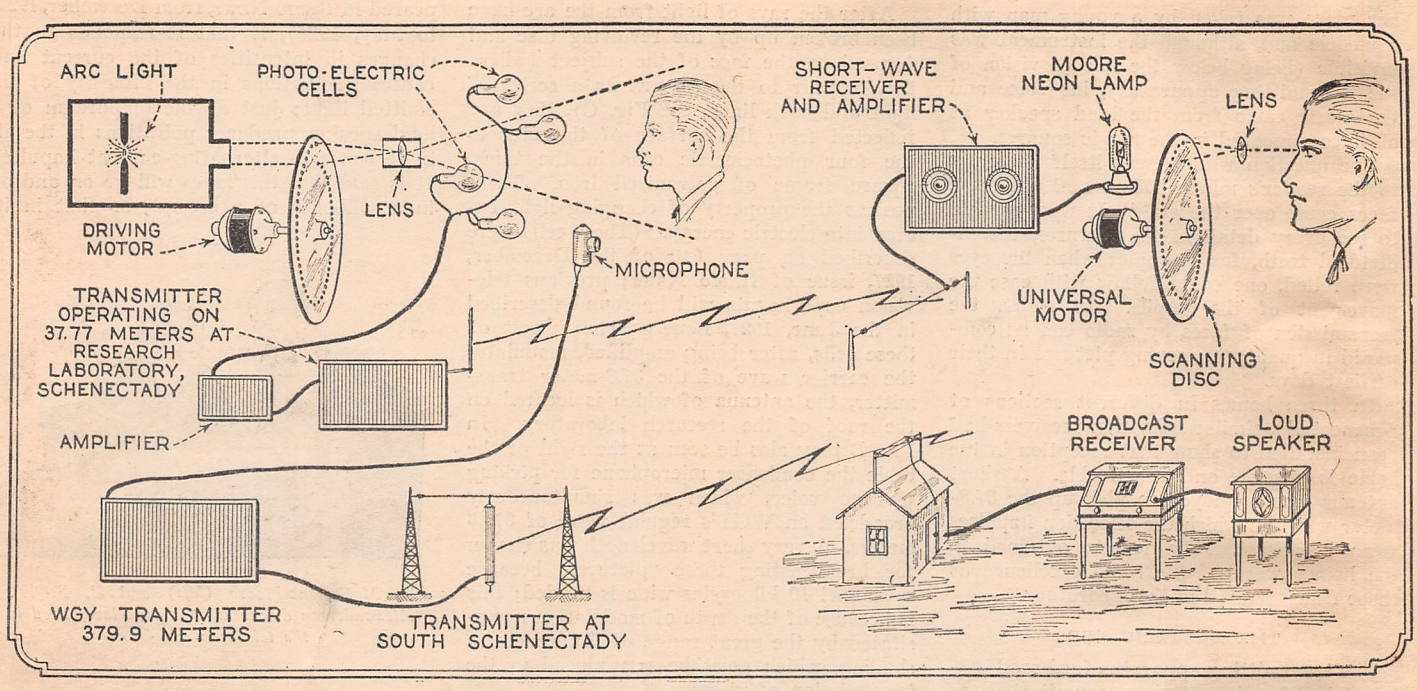


Fig. A at the left and Fig. B below show the relative positions of the apparatus used in transmitting by radio the image of the girl. In Fig. A the arc lamp is at the left and, between the revolving disc and the square frame holding the photoelectric cells, is the small square wooden holder carrying the lens. The amplifier is in the two boxes at the right. The grouping of the photoelectric cells is shown in Fig. B below, three being visible and a fourth behind the amplifier boxes. Note the microphone at the right and the lines of light and shadow on the girl's face in Fig. B; and the enlargement in Fig. C, at the lower left.



A diagram of the Alexanderson method of operation in the transmission and reception of television. At the upper left are the transmitter for the image and the microphone for the voice, which is broadcast on a different wavelength. At the right are the receivers for television and speech.

SYNCHRONIZATION BY HAND

In most of the television receivers built heretofore, there has been employed some automatic means of synchronizing the receiver with the transmitter; such as the broadcasting of a certain frequency that would make two motors run at exactly the same speed. In Dr. Alexanderson's system no such complicated method of synchronization is employed; the simple and only speed control is a push-button that varies the speed of the universal motor turning the disc.

When the receiver is first started the speed of its motor is far below that of the one at the transmitter, and the resultant image is a straight line of light. As the motor is brought nearer and nearer to synchronous speed, this line of light breaks up into a series of parallel lines, slanting first one way and then the other. Then there appears a distorted image of a face, again breaking up into splotches of light and dark. Finally, when the two motors are running in synchronism, a true image may be seen on the lens. This image constantly shifts from one side to the other, as the speeds of the two motors vary; but this shifting from side to side does not interfere with the reception, as the movement can be made to be very slow.

Here it is that the operator must exercise his skill, in keeping the received image as near the centre of the lens as possible. This is done by "whipping" the motor; *i.e.*, sending an electric impulse to the motor by means of the push-button, and thereby increasing the speed. This is far from being a difficult feat, as it requires no more skill than steering an automobile along a road. Sometimes, when the two motors get slightly out of synchronism, the lower half of the image may be above the upper; so that a man's collar and tie may be seen above his head. This condition can be easily adjusted, however; just as a like condition is remedied by the motion-picture operator when the picture gets out of its "frame."

In the lower part of the cabinet, which (as may be seen) is about the same size as that which houses an ordinary talking machine, is an amplifier with two rectifier tubes. A storage battery and dry-cell "B" batteries for the short-wave unit are on a shelf over this amplifier, which utilizes A.C. house current. By the use of a universal motor and the rest of the equipment as mentioned above, it may be easily seen that the television receiver is one that can be used in almost any home; the only provision being that 110 volts of either A.C. or D.C. be available.

NEW DISCOVERIES IN RADIO

When introducing his apparatus in preparation for the demonstration, Dr. Alexanderson mentioned the fact that he expects television to have within five years the same status that voice transmission has today. Of course, there are still a number of "bugs" that have to be eliminated before the apparatus can be put on the market for general use; but, considering the rate at which television engineers are progressing in their work, the time is approaching rapidly when it will be possible to see as well as hear the artists as they appear in the studio. (*Continued on page* 1156)

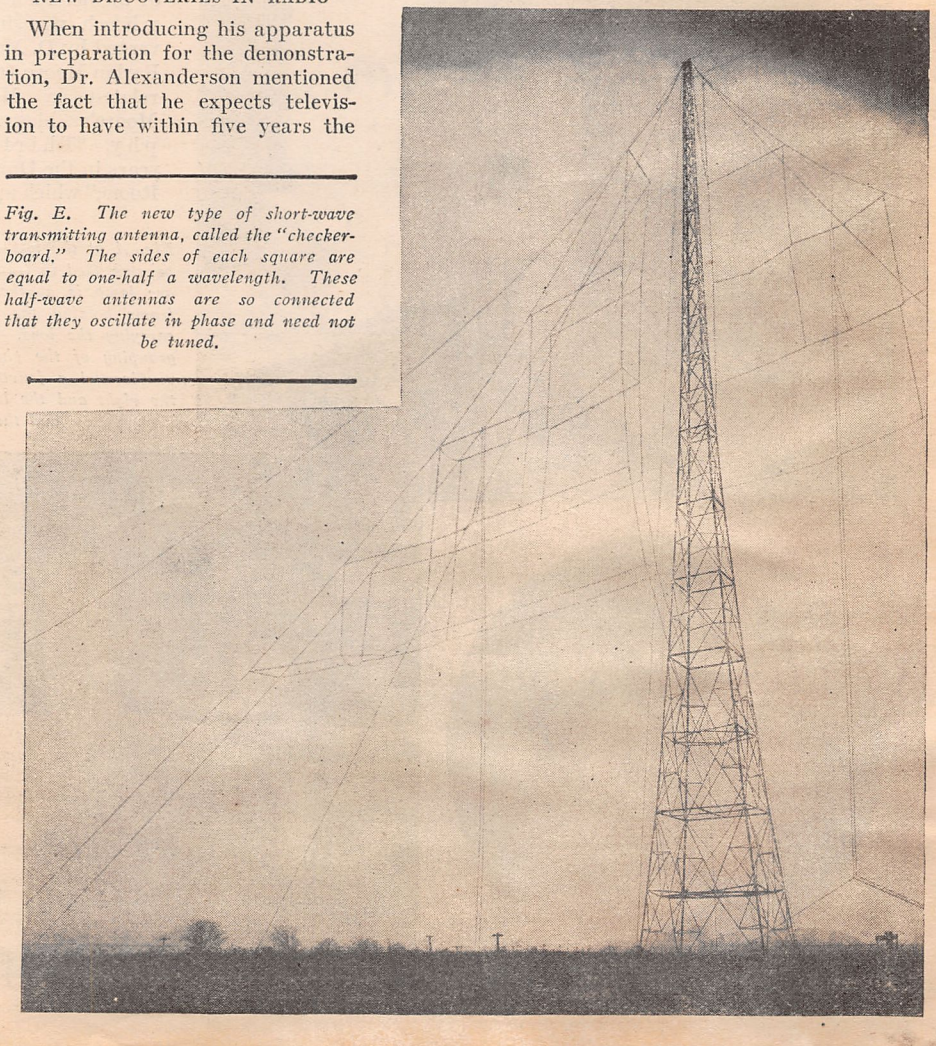
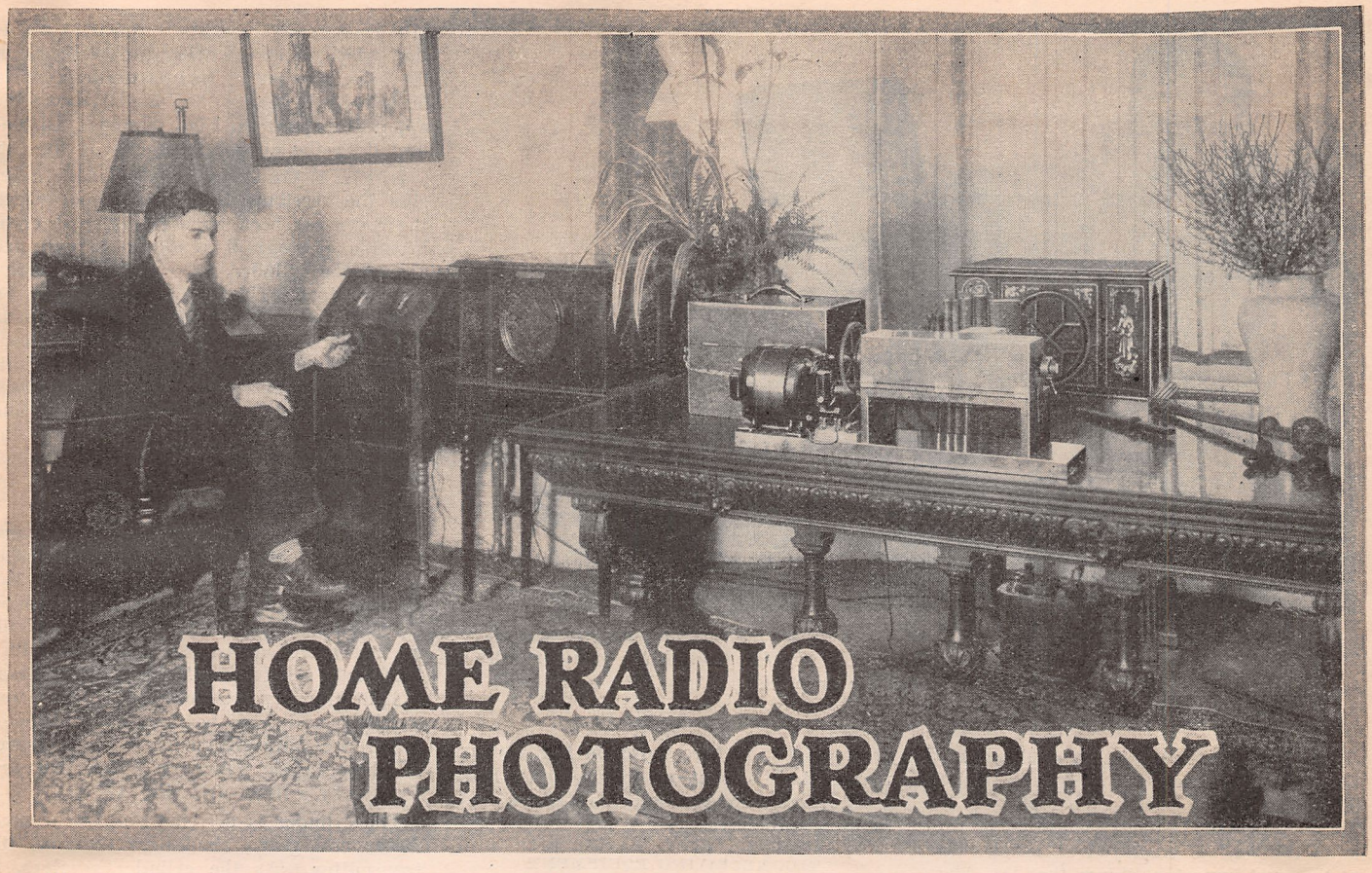


Fig. E. The new type of short-wave transmitting antenna, called the "checkerboard." The sides of each square are equal to one-half a wavelength. These half-wave antennas are so connected that they oscillate in phase and need not be tuned.



HOME RADIO PHOTOGRAPHY

Fig. A. The apparatus for receiving photographs by radio, inst alled in the home of Dr. Alfred N. Goldsmith in New York City.

NOT quite two weeks after "television in the home" had been successfully demonstrated in Schenectady, N. Y., the transmission of photographs by radio and their reception in the home was exhibited by the National Broadcasting Company in New York City. Dr. E. F. W. Alexanderson, consulting engineer of the General Electric Company, is credited also with the development of this simplified system for receiving pictures with apparatus that can be connected in the output of an ordinary receiving set. The pictures were broadcast on WEAF's regular wavelength of 492 meters.

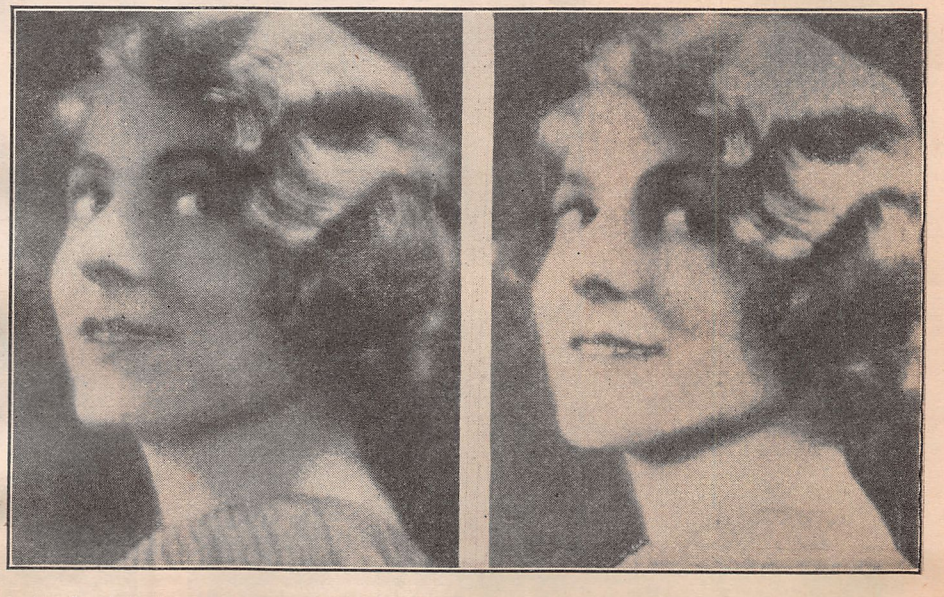
The apparatus demonstrated by Dr. Alexanderson is far from complicated, yet it does not seem quite as simple as the receiver for picking up television broadcasts. The transmitting apparatus was installed in a studio of the National Broadcasting Company, at 55th Street and Fifth Avenue, New York City. A photograph of the mayor of the city, the Hon. James J. Walker, was clamped around the cylinder of the transmitter, as shown in Fig. B.

As the cylinder is turned by a synchronous motor at a constant speed, a photoelectric cell, contained in the box next to the wall, transforms the light energy into electrical energy. The light is reflected to the cell from the surface of the photograph and is broken up by the revolving disc, which has a slotted edge. The output of the photoelectric cell is amplified and is connected to the regular broadcast transmitter, in this case at Bellmore, L. I., by means of land lines. At the WEAF transmitter the picture was put on the air, and received in the home of Dr. Alfred Goldsmith at 82nd St. and West End Ave., New York, (See Fig. A), a distance of approximately twenty-five miles. The results of this transmission, which took about 90 seconds, are shown in Fig. D. The photograph at the left is the original and the other the picture after it was developed in Dr. Goldsmith's home.

THE PHOTOGRAPHIC PICK-UP

In Figs. B and C are shown two views of the pick-up apparatus in the studio. Fig. B shows E. C. Ballentine placing a photograph of D. McFarlan Moore, the inventor of the neon tube used in the receiver, on the cylinder. In Fig. C the synchronous motor in the foreground turns the cylinder at a constant speed, properly reduced by the gears. A source of light is concentrated on a small portion of the photograph, this small area reflecting the light through a lens and the scanning disc to the photoelectric cell. (See Fig. 1.)

The rapidly-revolving disc, at the front end of the case containing the photoelectric cell, has around its circumference a series of indentations or notches. These notches interrupt the light rays at a certain frequency and the photoelectric cell is energized, every so often, by a reflected ray of an intensity which depends upon the depth of shade in the minute area of the photograph then being reflected. These variations of light are translated into electrical impulses by the photoelectric cell and after being amplified are put on the air as a modulation of the carrier wave.



At the left is an unretouched reproduction of an original photograph of Jessica Dragonette, WEAF artist, and at the right the unretouched picture, as it was received in Dr. Goldsmith's home.

Fig. E. Dr. E. F. W. Alexanderson is here shown beside his receiving apparatus. At the rear of the table is the special amplifier and, in the foreground, the receiver with the revolving cylinder exposed.

The ordinary transmitting equipment of the station is used, the only substitution being that of the photographic pick-up for the microphone. Ordinary land-line, or "remote control," is employed as usual. One of the most important things that Dr. Alexanderson has done, besides simplifying the apparatus, is the speeding up of the entire process. The picture shown in Fig. D was transmitted in about one minute and a half, a rate about twenty times as fast as that of other processes.

THE RECEIVING EQUIPMENT

One of the first requirements for receiving pictures from the air is an ordinary broadcast receiver. This is tuned to a station which is transmitting the pictures, in the same manner as though music were to be heard. Instead of the loud speaker the apparatus shown in Figs. E and F is connected to the output terminals of the set.

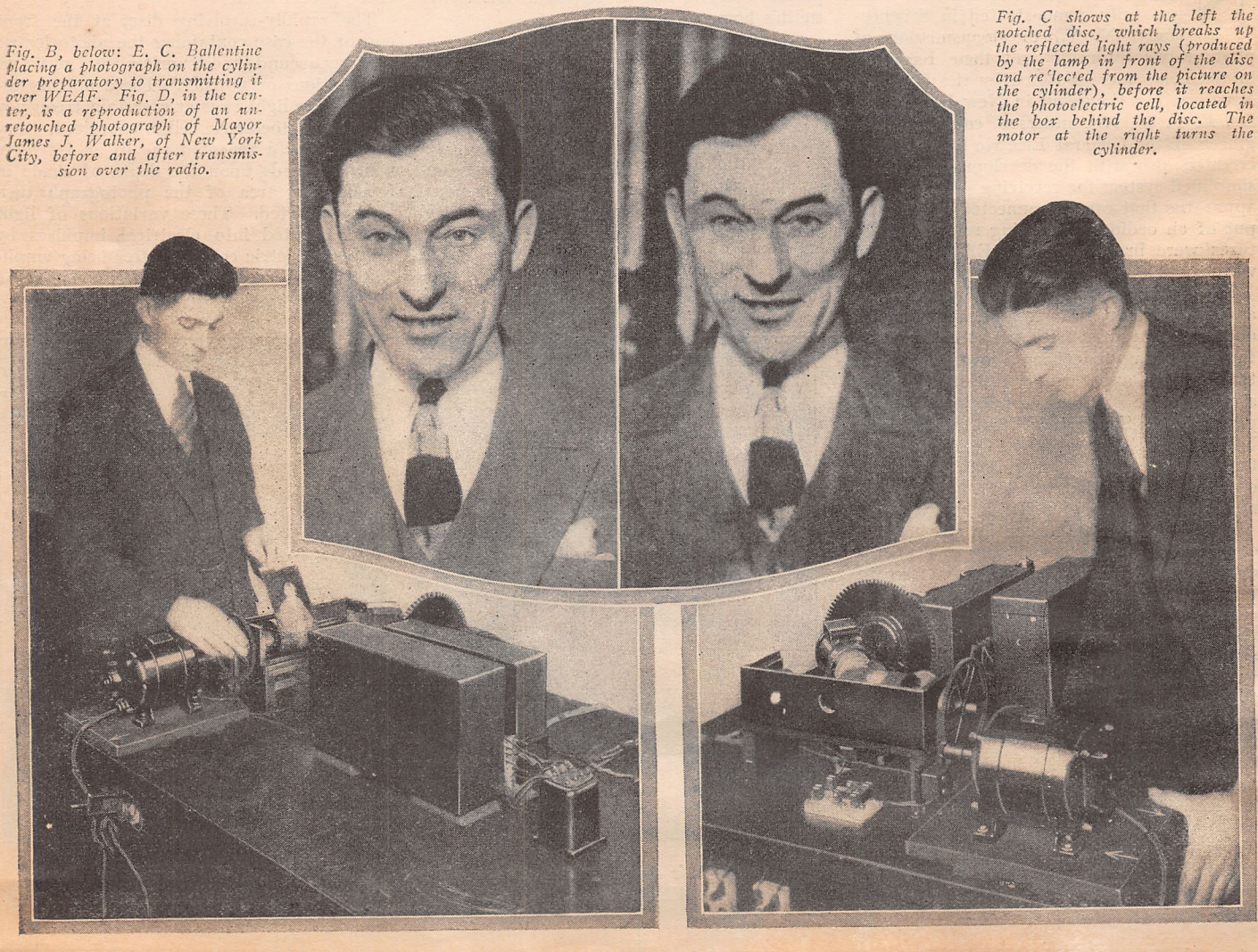
In Fig. E Dr. Alexanderson is shown beside the receiving apparatus, from which the cover has been removed. The sheet of bromide photographic paper is wrapped around the cylinder, preparatory to receiving a picture. This paper must, of course, be protected from the light of the room, until after its exposure to the light controlled by the incoming radio signal; this protection is afforded by a light-proof cover, which is shown in position in Figs. A and F. Standing open against the wall is the shielded box containing the amplifier, which strengthens the impulses before they are sent to the neon lamp.

This lamp, which operates on the same principle as the one used in the television apparatus, was also developed by D. McFarlan Moore. Instead of the tube's having a plate on which the images are built up, its central electrode is a rod, in which there is a small crater. By the variations in light intensity produced by the neon lamp the light and dark portions of the photograph are faithfully printed on the sheet of photographic paper, on which they are focused by a lens. (See Fig. G.)

The cylinder is driven by a synchronous motor and gears, similar to those at the transmitter. As the cylinder revolves, it also moves along a threaded rod, thus exposing the entire sheet of sensitive paper

Fig. B, below: E. C. Ballentine placing a photograph on the cylinder preparatory to transmitting it over WEAF. Fig. D, in the center, is a reproduction of an unretouched photograph of Mayor James J. Walker, of New York City, before and after transmission over the radio.

Fig. C shows at the left the notched disc, which breaks up the reflected light rays (produced by the lamp in front of the disc and reflected from the picture on the cylinder), before it reaches the photoelectric cell, located in the box behind the disc. The motor at the right turns the cylinder.



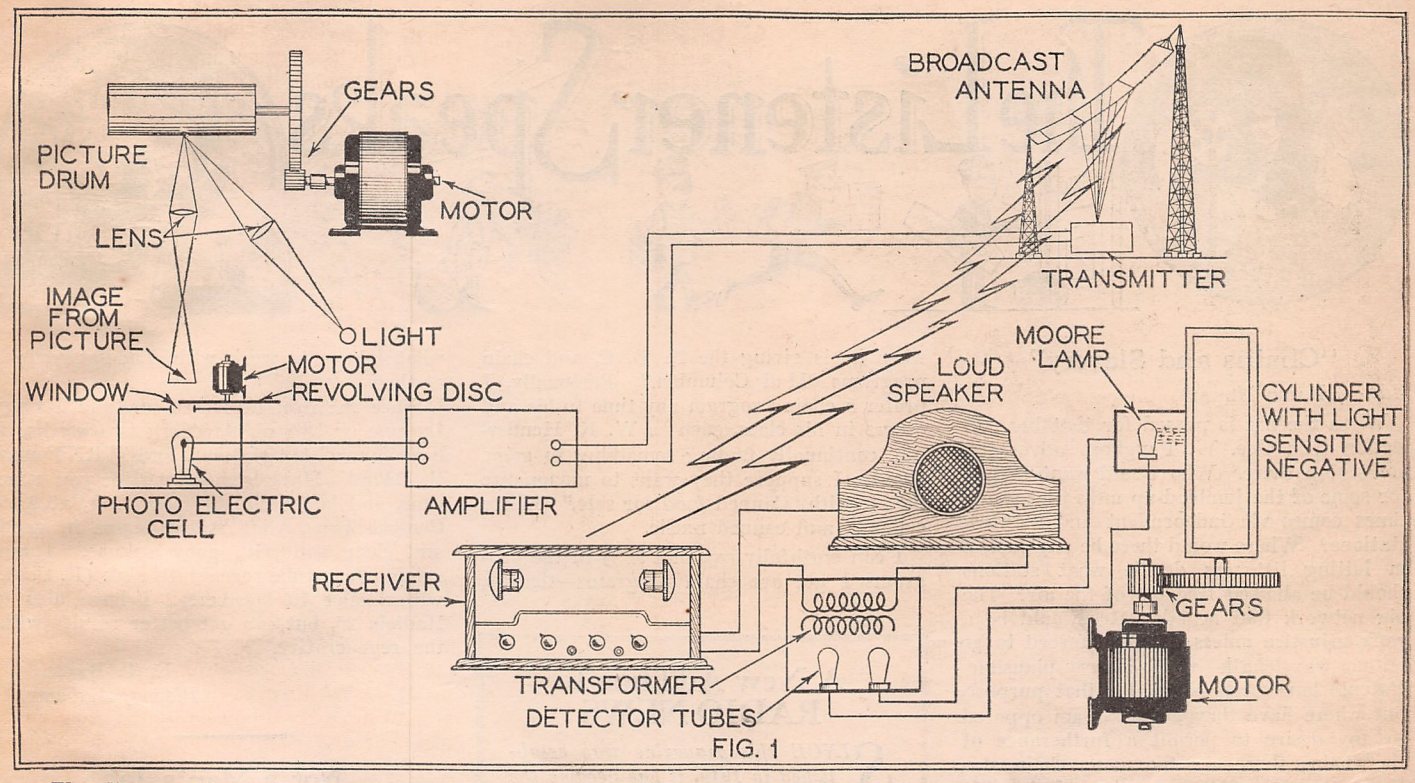
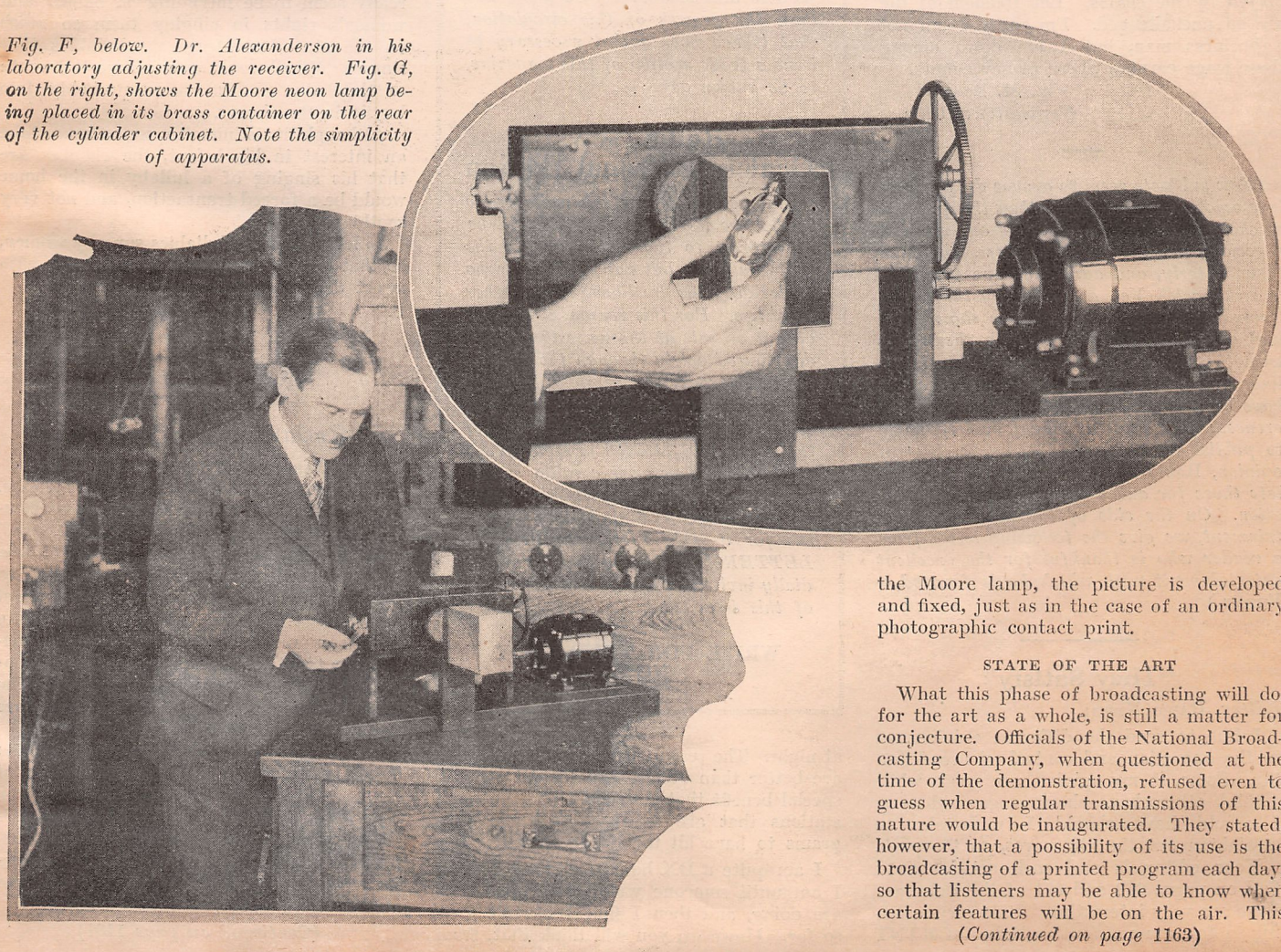


FIG. 1

The diagram illustrates the process through which a photograph goes when being transmitted through the ether. When it is finally received on the cylinder on the right, it must be "developed" and "fixed" as with an ordinary print.

to the light rays. Before the actual transmission of the photograph takes place, instructions from the transmitting station are broadcast and received through the regular loud speaker at the receiving end. A milliammeter on the box containing the amplifier indicates to the receiving operator when his receiver is properly "framed" and set to the correct intensity strength for tone shades. These adjustments are easily and quickly made. After the entire surface of the paper has been exposed to the rays of the Moore lamp, the picture is developed and fixed, just as in the case of an ordinary photographic contact print.

Fig. F, below. Dr. Alexanderson in his laboratory adjusting the receiver. Fig. G, on the right, shows the Moore neon lamp being placed in its brass container on the rear of the cylinder cabinet. Note the simplicity of apparatus.



STATE OF THE ART

What this phase of broadcasting will do, for the art as a whole, is still a matter for conjecture. Officials of the National Broadcasting Company, when questioned at the time of the demonstration, refused even to guess when regular transmissions of this nature would be inaugurated. They stated, however, that a possibility of its use is the broadcasting of a printed program each day, so that listeners may be able to know when certain features will be on the air. This

(*Continued on page* 1163)

"Chains and Slavery"

Editor, RADIO NEWS:

When the hat is passed for that big collection that Geo. W. Pangborn advocates, don't stop there. Who would want to pay for some of the jumbled-up mess that sometimes comes via independent and network stations? Where would there be any justice in letting listeners decide what stations should be allowed freedom of the air? The big network that he advocates would be a rank injustice unless all were forced to go on one wavelength—which is very plausible. Patents have been issued for that purpose, but where have they gone? I am opposed to any desire to permit a furtherance of the chain; there are too many chain stations now occupying a number of channels with the same program. Nightly there are 25 stations in one chain. Formerly we had a diversity of 25 different programs from those stations—who cares whether it is the highly-paid artists from New York that entertain us? Many times I have thought that undiscovered nincompoops provided better entertainment than those headliners played by the chains. Let freedom of the air go unchallenged. I'm sorry I am not a business man, but I am down among those wage earners where money counts.

W. M. BROWN,
Germantown, Ohio.

(Few subjects seem to arouse deeper feelings among radio listeners than the question of chain broadcasting. Many of our readers, especially in the Middle West, condemn them bitterly, and advocate "one program, one channel." Yet, as stated by the Radio Commission, the larger stations show more and more tendency to affiliate themselves with these costly programs, and the headliner talent they furnish. Many appeals have been made for a poll of listener preferences; and, while it would be impossible to publish all the individual expressions of opinion, RADIO NEWS *will be glad to tabulate those for and against the present situation. On the side of the network entertainment, we give the following letter from a reader who is thankful for the excellent entertainment with which he is favored.—*EDITOR.)

"They Satisfy"

Editor, RADIO NEWS:

I like to read the different opinions as to the operation and control of broadcasting. Some, in my opinion, are good; while I think others have about as good ideas as I would have should I undertake to straighten out the air waves, so to speak.

Your editorials and such articles as I find on pages 869 and 871 of the February issue are very interesting. It is very amusing to listen in on Norman Baker of KTNT when he is giving the N. B. C. and chain programs "Hail Columbia." Personally, I prefer a chain program any time to his and others in his class, such as W. K. Henderson, continually finding something to gripe about. I suppose they want to monopolize the air with "Canned food for sale," "Horse collars," and canned music.

I can truthfully say that 90% of the programs I get are chain programs—that is, at night. The reason, of course, is that they are better than others, and I can't see any special benefit that it would be to the small stations that are fighting the chain programs to have all the latter on one wave.

I am quite a DX hound; at least I think I am until someone writes you what they are doing, and then I find I haven't gone so far. However, you will think that, from what I have to work with, I'm not so bad at that.

Since the first of December, and I only try one or two nights every two weeks, I have logged 142 stations, and WRNY was the 142nd. Have been fishing for you some time, and last night (January 17), at 9:45 Central Time, your station came in good and clear and with good volume. I am using a four-tube regenerative set (R. C. A. with model 10 speaker.) I have also a Radiola 25, but can get better results with the regenerative.

E. T. BATES,
Plevna, Alabama.

A New Addition to RADIO NEWS

SINCE this magazine was established in 1919, *it has become the most important in the radio field in this country, if not in the world.* RADIO NEWS *has been read, not only by the radio amateur, the set builder and the set owner, but by practically everyone who is interested in radio. More than* 30,000 *of these readers are radio manufacturers, distributors, jobbers and retailers. So great has been the growth of this circulation, that it has been found necessary to issue a trade section of this magazine, to be known as*

Radio News Dealers Personal Edition

This section is for the radio trade ONLY, as its entire contents will be of interest to those who are in the radio business, but not to anyone who is deriving his livelihood from other activities. For this reason, it will not be put on sale at the newsstands, but distributed solely through the mail to the radio trade.

The publishers will be only too glad to send you, without charge, a copy of the new DEALERS PERSONAL EDITION, if you are a radio manufacturer, distributor, wholesaler or retailer. You can obtain it only by asking for it—ON YOUR BUSINESS LETTERHEAD—and you are cordially invited to do so. See page 1176 *of this issue, and*

WRITE FOR YOUR COPY NOW!

Not a Man's Job

Editor, RADIO NEWS:

I wonder if the women wouldn't all like (I know I would) to hear more lullabies sung over the radio by women singers instead of men.

Of course, it's fine to hear men sing lullabies, but in real home life it's the women who sing most of them, and the men really seem to be intruding on babies' and women's rights in singing them so much on the air. I'm afraid the lullabies they sing to "Mike" would only arouse the wrath of the baby, and it would probably join lustily in the chorus.

Although it is nice to see a man take an interest in his infant, the chances are that his singing of a lullaby in the home would be a forced transaction, and not very soothing.

So lets hear more lullabies sung by women, so that our minds may picture a baby with sweet drooping eyelids.

MRS. H. GERSTEN,
900 *Oakdale Avenue,*
Chicago, Illinois.

Radio for Every Flight

Editor, RADIO NEWS:

With reference to the recent catastrophe, the loss of Mrs. Frances Grayson and companions in her transatlantic plane "Dawn," I would appreciate it if you would publish, in your excellent magazine, a suggestion to future transatlantic fliers, and the general public, regarding the danger of inadequate radio equipment, heretofore used on transatlantic flights, and lack of trained radiomen, which is partly responsible for the complete disappearance of several planes and their occupants.

To give an instance of the value of radio on these flights, I will quote the case of Commander Byrd's successful flight from New York to Paris in "Miss America." Of all the planes, that have flown, or have attempted to fly the North Atlantic, I believe his plane was the best equipped in the case of a forced landing.

(*Continued on page* 1187)

Kathleen Stewart

Staff pianist of WEAF and a favorite of that station's large audience. She was featured in one of the recent Eveready Hours.

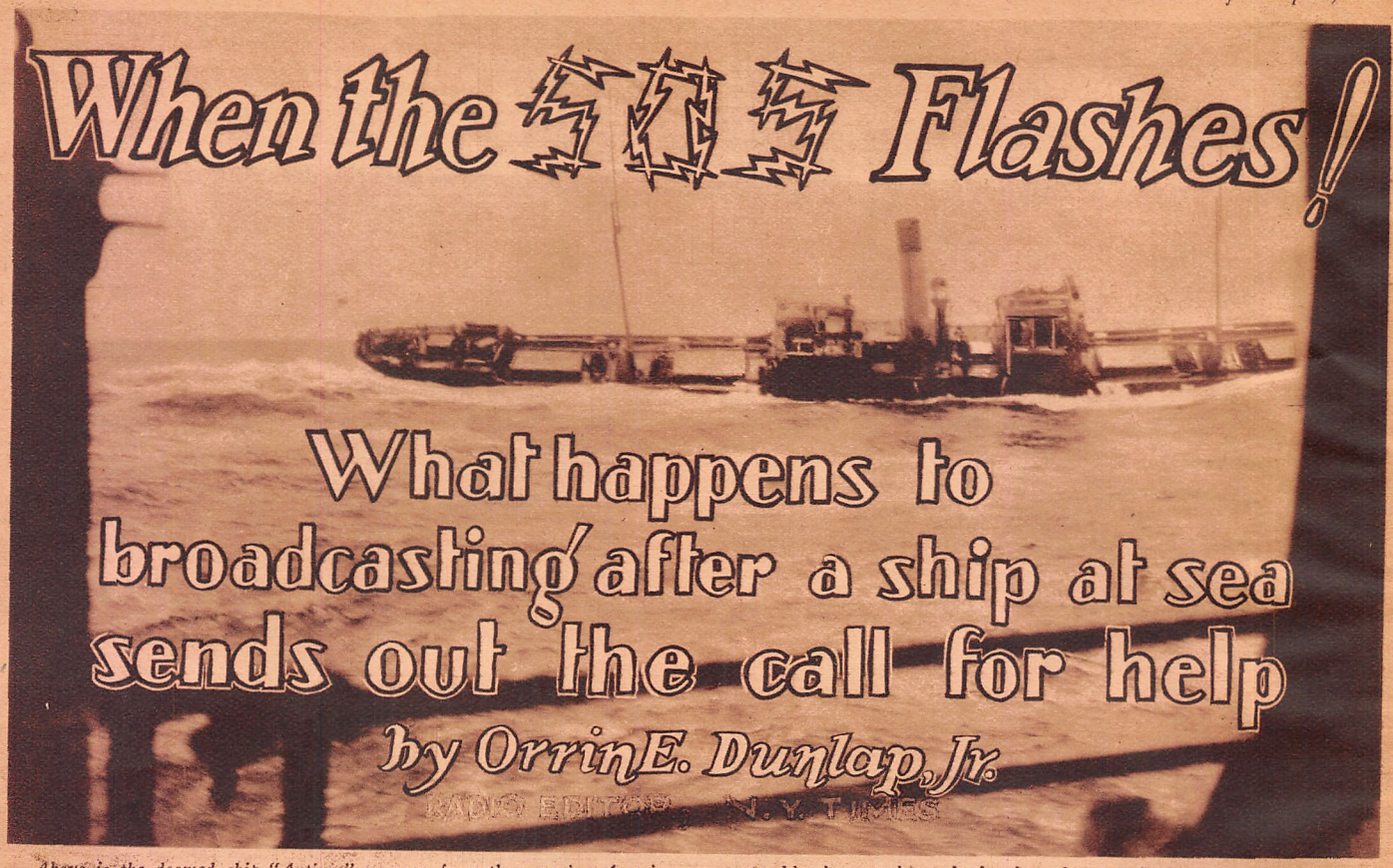
"Mickey" McKee

Whose unique ability as a whistler has made her an especially popular member of Roxy's "Gang."—Her first name is really Margaret.

J. Andrew White

Dean of radio sport announcers, who was recently appointed president of the Columbia Broadcasting System, second largest chain in the country.

When the SOS Flashes!



What happens to broadcasting after a ship at sea sends out the call for help

by Orrin E. Dunlap, Jr.

RADIO EDITOR, N. Y. TIMES

Above is the doomed ship "Antinoe" as seen from the rescuing American liner "President Roosevelt," which was summoned by an SOS to stand-by in a raging gale for four days, until the crew of the British vessel could be saved. © Herbert Photos.

DID you ever tune-in on the radio and find it "dead" for no apparent reason? The tubes burn in all their glory, but all is silent. You rush to the roof to see if the aerial is still there. Then you test the batteries; the voltmeter needle jumps to a high mark. Well, you do about everything imaginable in an effort to bring back the music, but every diagnosis fails. Why is the set "dead"? A radio service man will have to perform an autopsy. It is Sunday, of course; the radio store is closed, so the "doctor" cannot be summoned until morning. The home seems "lost" without its radio!

So you decide to go out to the movies, but you don't enjoy the show because, all the time, there is that tingle in your brain that such a fine radio set as yours *cannot* have anything wrong with it. It never failed before. No one was tinkering with it. And what makes it more aggravating is the fact that there is absolutely no symptom of anything out of order. You reason it all out in the movie theatre. At 10:30 you return home determined to perform the autopsy on the receiving set yourself. The switch is snapped and—lo and behold—the loud speaker pours forth its music! What a grand and glorious feeling!

But what could have been the trouble? The next morning you read in the paper that "An SOS silenced broadcasting for an half hour last night." The moral is—when the radio set goes "dead," have more confidence in it. Call up a neighbor and see if his loud speaker is silent too, before you become "expert" and begin the hunt for trouble. When a radio set owner begins to look for trouble he will find it, or, more precisely, create it, nine times out of ten. An SOS applies the most exacting test of the confidence you have in your receiver.

THE PROGRAMS GO ON

But what happens in a broadcast studio when the three dots, three dashes and three dots of distress flash in from the sea? It matters not who is facing the microphone, whether it be a staff bedtime-story teller or $67,000 worth of talent—the SOS has the right of way!

An SOS does not necessarily suspend the activities of all broadcast transmitters. The "key" stations of the radio "chains," as they are on the Atlantic seaboard, may go off the air; but the program is sent out over the wire lines to the inland network, unaffected by the call from the sea. In fact the artists continue to entertain blissfully unaware that an SOS has greatly reduced their audience.

When an SOS silences broadcasters along the Atlantic seaboard at night, it opens up for the DX fan an excellent opportunity to tune for the elusive waves of distant stations. An SOS clears the New York air for broadcast reception, like the arrival of midnight when many of the eastern announcers bid their audience good-night.

It is seldom that such broadcasters as KDKA, Pittsburgh, and others west of the smoky city sign off because of an SOS. But the fifty-two transmitters nestled in the metropolitan area of New York go off the air immediately; because the big transmitter known as WNY at Bush Terminal, in Brooklyn, N. Y., or that of NAH at the Brooklyn Navy Yard instantly endeavors to calm the ether and establish communication with the ship in distress, or with other vessels in the immediate vicinity. A 2-kilowatt "spark" transmitter is used at such times, because it radiates a much broader wave than a vacuum-tube outfit and, therefore, is more likely to be intercepted by a greater number of stations when it broadcasts *"QRT* (stop transmitting) *ship in distress."*

THE RIGHT OF WAY

The Federal Radio Commission is authorized to designate radio stations the communications of which are liable to interfere with the transmission or reception of distress signals from ships. Such stations are required to keep a licensed radio operator listening in on the wavelengths designated for distress calls, during the entire period while the broadcast transmitter is in operation.

Every radio station on shipboard must be equipped to transmit distress calls on the frequency or wavelength specified by the licensing authority, with apparatus capable of transmitting and receiving messages over a distance of at least 100 miles by day or night. When sending signals of distress, the transmitting set may be adjusted in such a manner as to produce *"a maximum of radiation irrespective of the amount of interference which may be caused."*

The radio law stipulates that, "All radio stations, including government stations and stations on board foreign vessels when within the territorial waters of the United States, shall give absolute priority to radio communications or signals relating to ships in distress; shall cease all sending on frequencies or wavelengths which will interfere with hearing a radio communication or signal of distress, and, except when engaged in answering or aiding the ship in distress, shall refrain from sending any radio communications or signals until there is assurance that no interference will be caused with the radio communications or signals relating thereto, and shall assist the vessel in distress, so far as possible, by complying with its instructions."

So while you are sitting comfortably at home enjoying the Goldman band, the Edison String Ensemble or the New York Philharmonic Orchestra, just picture the licensed radio operator on his tiresome watch, wearing the headphones connected to a set tuned to the 600-meter wave, not so far above the broadcast band. What does this man do if he hears the three dots, three dashes and three more dots?

When a radio watchman in the New York area hears a plea for assistance, he first

verifies it by telephone with the District Communications Superintendent of the Navy Department in the Whitehall Building, which is in constant touch with the Brooklyn Navy Yard station, NAH.

THE CODE SIGNALS

Many times, before the watchman at the broadcast transmitter has had time to verify the call with the District Communications office, NAH flashes *"QST DE NAH QRT SOS"*—meaning, in the parlance of dots and dashes, *"General Call from NAH, clear the air because of an SOS!"* This is an order to all stations in the district to sign-off, whether they be broadcasters, ship or shore transmitters. When this call is heard—or before that time, in the case of an SOS which has been intercepted by the watchman and verified by the District Communications office—the operator at the broadcast transmitter immediately tips a little switch which cuts the station's program from the air. Then speaking into a microphone, he announces that the station is signing off because of an SOS. The transmitter is silent, but the tubes are kept burning because, generally within a short time, the air will be clear again.

In the meantime, code transmitters from Cape Race to Key West are endeavoring to communicate with the disabled vessel, using for this purpose every fraction of the power they possess. The Navy Yard station continues to send out its warning, in case a ship unaware of the SOS begins to transmit.

Broadcast listeners who are able to read the Continental Morse code and the quick flashes of radio abbreviations can often follow the rescue arrangements; for the broadly-tuned signals will penetrate into the upper reaches of the broadcast band. Usually, one shore station will direct the rescue, and within a short time this station will have communicated with vessels close to the ship in need of assistance. In communicating with the coast station, ships first ascertain the position of the disabled vessel and then report their distance from the ship in hours. One or two vessels will be assigned to speed to the rescue and, once they have changed their courses, the "All clear" signal, which is two dots-space-dot, is sent out by the land station and broadcasting is resumed.

EARLY DAYS OF "WIRELESS"

Do you know the evolution of the cryptic "SOS" that silences your radio? It really begins with the first marine accident to be reported by "wireless," on April 28, 1899 (long before the days of broadcasting), when the steamer *R. F. Mathews* collided with the East Goodwin Sands Lightship, off the coast of England. The call for help was picked up by a shore station twelve miles away and a rescue party was dispatched to the scene of the wreck, reaching it in time to save all lives. This proved the value of radio at sea, and revealed the necessity of an international distress signal which could be understood easily by the operators of all nations, despite differences in language.

The call "SOS" passed through a process of evolution. The first suggestion for an international distress call for ships was made by the Italian delegates at a preliminary meeting to consider radio telegraphy, held at Berlin in 1903. The Italians suggested the adoption of "SSSDDD." All agreed that such a call was needed but the choice was left to a special conference. Shortly after the Marconi Company instituted "CQD."

Erroneously, "CQD" was translated by the public to mean *"Come Quick, Danger."* It was one of the signals radio adopted from the land telegraph which, because of its higher state of development, was governed by rules formulated and established by an international convention. Among the telegraph rules was the authorization of a group of double-letter symbols used by operators to abbreviate and speed-up traffic.

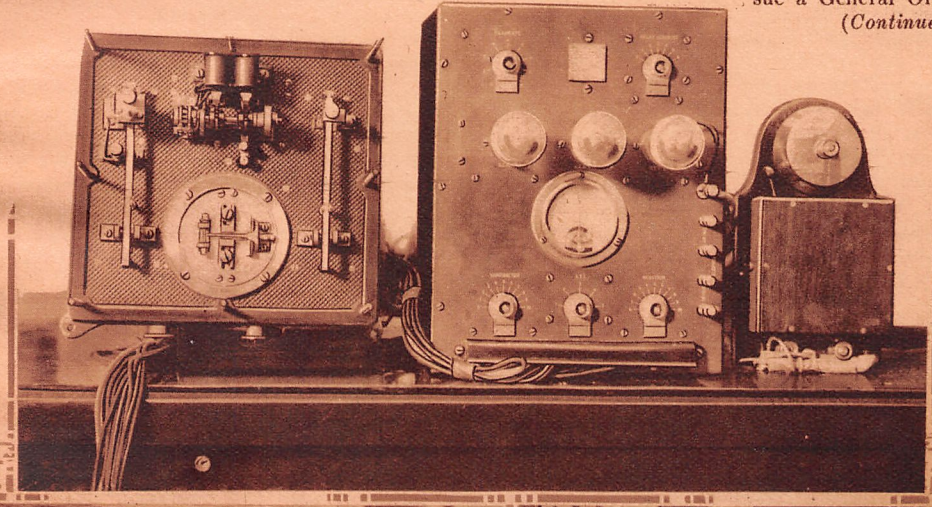
"Q," being one of the least-used letters in the English alphabet, is distinctive and can be recognized easily. The call "CQ" on a railroad or commercial telegraph line means that the operator sending it desires all other operators along the wire to listen to his message. When radio adopted "CQ," it took the meaning *"Stop sending and listen."* Alone, it is important but no cause for immediate alarm. But, in the early days of radio, if the operator followed the "CQ" with the letter "D"—the signal of danger and distress—it became a message of general alarm.

So harmless is the "CQ," without the "D," that even today it is a custom among amateurs and commercial operators to send "CQ" in dots and dashes as a signal that the station is on the air and free to handle traffic.

"SOS" FROM THE "TITANIC"

Several minor emergencies at sea revealed that "CQ" did not sufficiently express the urgency required for distress purposes. This prompted the Marconi Company to issue a General Order "Circular No. 57" on

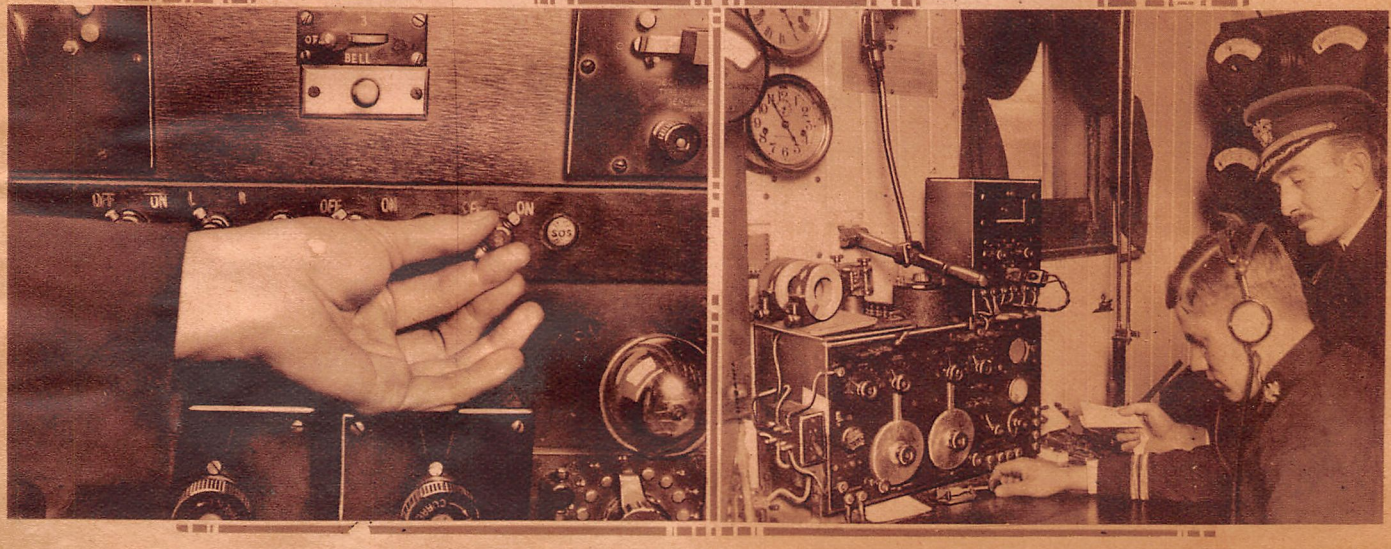
(*Continued on page* 1160)



Below (lower left), the switch which is turned at station W E A F when a SOS is received by the operator who keeps constant watch. This disconnects the remote-control line from the transmitter and broadcasting stops, so far as this station is concerned; though inland stations may continue.
© Herbert Photos.

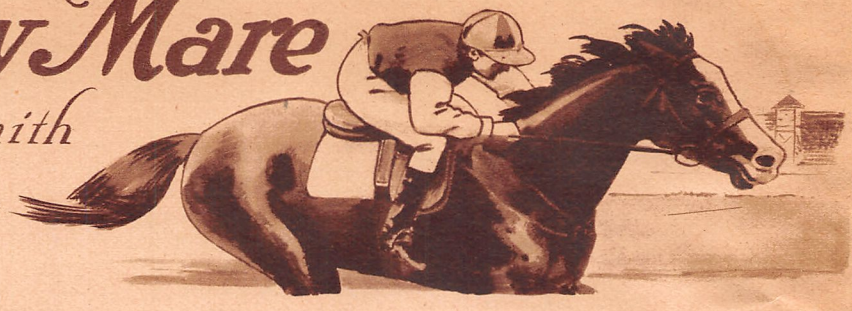
In the center, above, is the latest Marconi Automatic alarm apparatus which takes the place of an operator in watching for SOS signals. It selects the distress signal from any other messages and sounds a bell.
© Wide World.

B e l o w (at the l o w e r right), a view of the operator's room on the SS. "Southern Cross," showing receiver and telegraphic transmitting key.
© Herbert Photos.



The Old Dray Mare

By Robert Francis Smith



"—I've got you logged, and my dials are set. Your program's nice and loud on my super-het; and Long-Wave Papa, you ain't a-gonna fade on me!"

IT'S one of those August afternoons just made for white duck pants, a stiff breeze and a sunburned neck, and I'm out on the Sound in our new speedboat, *Bow Stealer,* practicing the lyrics and learning the libretto of *My Radio Girl*—the oncoming season's musical smash, if you believe the producers. Suddenly the telephone rings!

No, it's not the heat. Besides studying my part I've been helping The Master in some minor experiments, and we've a flock of apparatus aboard, including a small twenty-meter radiophone, with an auxiliary transmitter to ring a bell, so's I won't have to keep the cans on in the sun. I grabs the instrument and answers Jerry.

"Go out beyond Buoy 3," he directs, "and turn knob B-44 on Panel 2 until the red indicator on Dial 6 registers 18.5."

I haven't the least idea what it's all about, but being wedded I can obey orders; I does as asked and shortly receives The Master's thanks, and the request to come ashore and help somewhere.

Formally, I'm Joe Hammerstein, dancing comedian, and reside with my exit-light, Doris, and four radio sets, at Brightmere-on-the-Deep, Long Island. We're due to begin rehearsals with a musical comedy next week; and, as a novelty, they've given the opera a plot, so we've lines to remember.

Jerry Lawson, alias The Master, is our local gift to science; he's twenty-five, tall, slim, dark-haired, a power in Wall Street and an authority on radio. Once, in the fall of '09, he was known to make an original wise-crack, wholly by accident; since then he's basked in its memory and turned his mind to higher things like aerials.

I runs the boat up to the dock and Jerry helps me take the stuff back up to his joint. We putters around up there for a coupla spasms, until the evening papers arrive. The Master always allots a certain daily period for getting the low inside on how the other half lives, and he flops into his old morris chair with a lapful of sheets. I'd not have given any thought of it, only I happens to get a slant at one of the papers. It's a publication devoted exclusively to the art of losing currency on the ponies.

Jerry plays a scientific hand of bridge—he would—and can, when in the mood, be astute at poker; also, on certain memorable occasions, the dice have displayed remarkable gathering proclivities while under his guidance. But he's not essentially a gambler, unless it be for a principle; that he's taken up horse racing is a new one on me, and I've known him four years.

"Since when?" I demands, seizing the sheet. "And at your age, too! I thought you knew better!"

The Master smiles faintly. "Only morbid curiosity, Joe," he answers. "Curiosity plus a mild determination."

"To what—beat the game?" I inquires. "Don't tell me you've worked out a system!"

Jerry almost laughs out loud. "I fear you've misconstrued my meaning," he replies. "No, Joe, I'm not gambling. But the career of one horse is interesting me strangely."

"Other people have been affected the same way," I grins. "Only they had to walk home. What's the racket this time?"

I hands him the paper, and he hunts through it until he finds the results on a certain race, away back in the sticks. His face sorta tightens, and then relaxes, with an expression of puzzled annoyance crossing his handsome map.

"Again!" he mutters.

"No!" I exclaims. "Impossible!"

"But she did—oh, you're fooling!" declares Jerry, coming out of his daze. "Joe, did you ever play the horses, as they say?"

I grins. "Prior to annexing Doris I blew my split-week savings on the Saratoga Ships, but none of them ever made port. In recent years I've been kept in sight too much."

"What I mean is, do you know the customary methods of betting, and have you any acquaintances in the game?"

"More than I know what to do with," I grins, making a wry face. "I wouldn't wish any of those touts on you, though. Why?"

The Master sits up, and it's plain the old dome is working without static. "I never would have learned about this, except for a casual friend who wrote me from upstate."

"Yes?"

"The particular horse involved runs under the cryptic name of Fuse Plug; it is an outlaw, of course, playing only the minor events at small county fairs."

"Fuse Plug!" I snorts. "What's his capacity?"

"From Harry's description, the animal seems to be an old mare and, while originally of racing stock, has been in commercial service on a transfer line until this spring."

I nods. "So far so good."

"But, no," declares The Master. "This horse, Fuse Plug, while only entered in free-for-all meets, invariably wins first prize by the simple trick of lagging until the final stretch, and then rushing ahead in a final blaze of glory."

"Common enough," I disparages. "The nag can't stand up under a continuous grind. They save the steam for the end."

"I realize that," mumbles Jerry, again perusing the paper. "Yes, here it is—the horse is nine years old, but has never been beaten since the opening of the season."

"Framed," I states, laconic. "Those gyp horses run under cheap syndicates, and it's all pre-arranged."

The Master shakes his head. "No, Joe, this case is different. Harry saw her race five times, and in each instance Fuse Plug performed as I just told you."

"Doped, perhaps."

"A drug could hardly be regulated to take effect at a given moment," argues Jerry, "and even so, it would be noticed. While the supervision at these small races is not thorough, it would nevertheless be difficult to use a stimulant of that nature without eventually being apprehended."

I scratches my dome. "They used to use a battery and a spark coil, to shock the horse," I offers.

Jerry arises and paces the floor. "That seems to be eliminated, too. There have been other inquiries concerning Fuse Plug. Indeed, it is only through her peculiar

"The box in the barn contained a radio receiver tuned to one wavelength and operating the main switch to the primary, which gave Fuse Plug the radio whip."

method of running that the racing sheets even list her exploits. Harry tells me that authorities, including the S. P. C. A., have gone over the animal, but have been unable to find any traces of either drugs or other artificial means. There is something inordinately clever about it all. I should like to investigate."

"Hop to it," I says. "Need any help?"

"When do your rehearsals start?"

This was a Monday. "A week from tomorrow," I replies. "Can we catch Fuse Plug somewheres near here by then?"

Together we goes over the paper and finally locates a dinky county-fair outfit that's billing Fuse Plug to run for three days.

"Tuesday, Wednesday and Thursday," reads Jerry. "Why, that's tomorrow. I've been through the town—it's only seventy miles upstate. Will you come?"

"Delighted," I answers. "Have you any idea what it's all about?"

The Master nods vaguely. "I've several theories, but I'll have to do some experimenting first. We'll drive up in my lab truck."

This latter is a small, inconspicuous car with an enclosed body, like a delivery wagon. The Master uses it on tour, and at times when he don't want to be bothered by spectators. The bus is built low, and has a straight-eight motor—there have been times when speed was very, very necessary.

Early the next morning we drives up to the fair. Our plans have been made; in order not to create suspicion, I leaves The Master just outside the town limits, and walks in as a hick visitor. Unless he needs me, in which case he'll signal, I'm to meet him after the races at this spot.

According to our arrangements, I'm to watch Fuse Plug run and, if she wins, go to the management and claim the horse is crooked. This is to give me a chance to inspect the animal at close range, also the jockey and saddle.

The Master gets an infield permit—he's supposed to be a news-reel photographer, and fusses with a camera for atmosphere—and drives up to the turn just above the home stretch. Should we pass each other, we're to be strangers. All's lovely.

Our horse is entered in the third, with a field of nine; one look at her is the cue for a big howl.

Fuse Plug was a racing filly once, but she's sorta forgot herself and grown heavy. At that, though, the beast has pep, and is in good trim for her age.

I mixes with the gang until the track events come up. Then I privately places a wager on Fuse Plug—just a hunch, and Doris'll never be the wiser—and edges through to the rail.

At the start Fuse Plug brings up the rear, but she holds her own, and in spite of her apparent clumsiness it's plain she once knew how to run. Until they rounds the curve where our truck is parked Fuse Plug remains last; then the mare suddenly whoops into it, passes the others like a Parisian taxicab, and crosses the line a winner by two lengths!

Something spurred that horse on, and it wasn't ambition!

Then I quietly collects, so as not to run too much risk of being identified later. Somebody might recognize me as having won; but only the payoff guy was there, and he was still busy when I put in my kick.

I finally gets a chance to examine the nag, with a couple other bozos that says they lost. Nothing wrong with the horse, nor with the jockey. The saddle is regulation.

"I guess she's square," I mumbles to the owner. "Sorry."

I walks to our meeting place and pretty soon The Master rolls along. He hasn't much to say, but I can see he's learned something, so I stays shut and lets his brain function.

The next day, Wednesday, Fuse Plug is due for a double-header, morning and afternoon. We're there again, early, and apparently separately.

Just before we reaches my stop, Jerry confides a few facts.

"Across the track from where I parked, on the outside, is an old barn, abandoned as a part of the fair grounds except for storage. I shall have to explore that immediately. In the meantime, you keep your eyes open, and be ready for anything."

"O.K.," I replies, saluting.

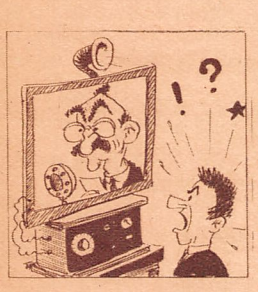
The morning race goes off just like the one the afternoon before. Fuse Plug does

(*Continued on page* 1164)

He shows the fat Mayor the saddle. The official grunts. "Battery?" he demands. The Master shakes his head. "No, strange as it may seem, Fuse Plug was controlled by radio." But strange to say nobody slips Jerry the bird.

Broadcastatics

PAPA WAS NO JACK BARRYMORE!



Mother (wife of famous radio announcer): "Now run along to bed, kiddies; and, when you say your prayers, don't forget to do as daddy said, and pray that television may never come." — *Wm. G. Mortimer.*

THE CONTROL THAT FAILED

First Housemaid: "Is Professor Wise absent-minded?"

Second Ditto: "Is he? Last night, when the baby cried, he twisted its nose to eliminate the static."

THE BOOKSHELF UP-TO-DATE

Lydia: "I've often thought how romantic it would be to be cast away on a desert island."

Nydia: "What ten-tube set would you take with you?"

POSITIVELY THE LATEST

Van: "He's the last word in radio announcers."

Phan: "Yes, he's the guy who signs off the station every night!"

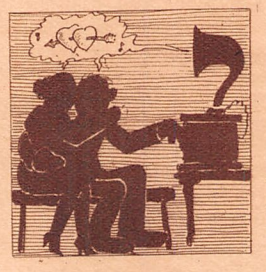
—Wm. G. Mortimer.

SPEECHES GO ON FOREVER

First Wearied Voter: "What did you think of Senator McBuncombe's speech over WAAK last night?"

Second W. V.: "I think they ought to have given him a shorter ravelength."

TOO TECHNICAL!



Mabel: "I just love to sit with Jim in a darkened room with the radio playing soft music.."

Marjorie: "Oh, I might with some boys—but Freddy *will* keep both hands busy on the dials."

NOT A BARK IN A BARRELFUL

Hoques: "Say old man, how do you manage to get such perfect radio reception?"

Joques: "I blow New Silver cigarette smoke into my loud speaker, to ease its throat."

THIS page is devoted to humor of purely radio interest; and our readers are invited to contribute pointed and snappy jokes—no long-winded compositions—of an original nature. For each one of this nature accepted and printed, $1.00 will be paid. Each must deal with radio in some of its phases. Actual humorous occurrences, preferably in broadcasting, will be preferred. Address Broadcastatics, care RADIO NEWS, 230 Fifth Avenue, New York City.

HOW HE REMEMBERED

Chance Acquaintance: "So you live in Wolfville, eh? Didn't you have a terrible storm down there last summer?"

Radio Fan: "We sure did. That was the night my aerial blew down."

NOR THE AUDIENCE (LUCKILY)

First Microphone: "A good mike is a broadcaster's best friend."

Second Microphone: "Yes, it will never tell him when he has halitosis."

NO DOUBT ABOUT IT!

Loud Speaker (in its best static manner): "Bang! *Crash! Help! Police! Murder!! BANG!!!*"

Radio Fan (whose location is more pacific): "Hooray! I've got Chicago!!"

—Mrs. Bill Howard.

NOT THAT KIND

Johnnie: "I got Greece on the radio last night!"

Mother: "Well, you wipe it off before your father sees it!"

—Leslie Carpenter.

ALWAYS FOLLOW INSTRUCTIONS

Sharpe (radio expert: "What on earth are you grinding up that copper wire for?"

Dulle (radio novice): "Well, I'm putting in my radio set and Radio News says a good ground wire is the most important thing about the installation."

—Paul Harvey.

SOLVING THE MYSTERY

Doctor: "You're color-blind, my good man!"

Jones: "Ah! I bet that's why I always get the Blue Chain program when I try to tune in the Red!" — *Wm. G. Mortimer.*

RADIO RHYMES ..... No. 6

Dr. de Forest Talks on Radio

Forecasts of the Near and the Distant Futures of Broadcasting, Television, Radio Apparatus and Radio Entertainment

IN the "Home Science University" series of Station WRNY, broadcast on January 11, 1928, Dr. Lee de Forest was interrogated by the Editor of RADIO NEWS on a number of radio subjects. The entire interview is published, *verbatim.*

MR. GERNSBACK:—The questions which I am going to ask you tonight, Doctor de Forest, are put to you in such a way as perhaps the man in the street would put them to you, if he had the opportunity or, may I say, the good fortune to speak to you. I shall try and make the questions as simple as possible; because you appreciate that, perhaps, not all of our listeners are technically inclined, and few can know all the technicalities. The first question is:

"What do you consider the greatest step in radio progress for the year 1927?"

DR. DE FOREST:—Mr. Gernsback, before I answer that and the following questions, I want to say to the radio audience, that my remarks tonight will not be too technical. From the tenor of the questions which are being proposed to me, I am talking on strictly radio technical matters; but I trust that I will use language that those really interested in radio will understand. Now in answer to your first question, I consider that the most important radio developments in 1927 come under the heads of the rapid elimination of "A" and "B" batteries for radio receiving sets, and the progress in the development of short-wavelength broadcasting. Great progress has also been made during the past year in the simplification and standardization of tuning devices; so much so that, for all local work, the single-dial control, even though this may operate three or four condensers, gives fine selectivity and adequate volume. The DX fan still wants individual-stage control with vernier condensers; but the great mass of radio listeners, who now overwhelmingly preponderate in and around our larger cities, are rapidly becoming educated to the fact that the very best they can obtain of radio anywhere comes from nearby stations. Therefore the extreme accuracy in tuning each individual R.F. amplification stage, in order to pick up with maximum volume long-distance stations, no longer appeals as it did.

MR. GERNSBACK:— Thank you, Doctor. Another question:

What are your views on the present broadcast art?

DR. DE FOREST:—It is a source of immeasurable gratification to me to observe the very marked increase in the quality of musical programs now being broadcast, as compared with that of two years, or even one year ago. This is particularly noticeable on Sundays; a lover of good music may then listen to his radio for hours at a time and hear nothing but music of the highest order. Today's radio is abundantly making good my prediction of many years ago, that radio would be instrumental, as no other institution of man's creation possibly could be instrumental, in a rapid development of the public's taste for good music. Countless thousands are now educated to hunt for and genuinely appreciate a type of music of which five years ago they were entirely ignorant, or under no conceivable condition would trouble themselves to hear. This cultural influence of radio is cumulative, accelerative. I have no doubt that, five years from now, most of the cheap jazz and mediocre music which the public now enjoys will be as distasteful in the United States as it has always been among the more cultured and music-loving peoples of Europe.

Dr. Lee de Forest

MR. GERNSBACK:—That probably answers the next question, which I shall put to you anyhow.

In what directions do you think present broadcasting should or can go? What are your views?

DR. DE FOREST:—That calls for a somewhat more technical answer. As to the technical developments awaiting us in 1928, I am sure that great strides will be made in the matter of improved quality of reproduction. The better type of console radio with built-in loud speakers, particularly the higher-priced ones with phonograph combined, will be more and more in demand. And as prosperity becomes more widely distributed, and particularly as the educative influence of radio, above mentioned, works its indirect benefits, more and more will discard their cheap "noise-boxes" in favor of more expensive and properly-designed amplifiers and loud-speakers. Much progress will be made in 1928 in the field of broadcasting with short wavelengths below 50 meters; but it will take more than one year to iron out successfully the intricate difficulties involved in building reliable receivers for operating on such short waves. It will be a long and slow process of infiltration that short-wave broadcasting must undergo before it can invade, to any large degree, the popularity which the present range of broadcasting channels now enjoys.

MR. GERNSBACK:—Dr. de Forest, you probably read a few days ago, that Harry Lauder said he would never broadcast. He said the present reception is not at all what it should be. I don't know whether you read that in the newspapers. That brings the question:

"Wherein does the present-day radio set fail, if it does fail?"

DR. DE FOREST:—I had not read that article; but it exactly fits with a statement made to me at luncheon today with a friend who recently met ten of the Players at the Players Club. He said he talked with them about radio, and he found that only one of the ten owned a radio set; five of the ten had owned radio sets but, with their ears so well trained to fine enunciation and fine music, they discarded the sets; and the other four were not interested in radio.

Many present-day radio-sets are deficient in the quality of their audio amplifiers and particularly in the loud speakers employed. The radio-frequency and detector systems have attained a high state of refinement, but too little attention has been paid up to date to the audio-frequency-amplifier end of the receiver. Too little iron is used in most of the transformers; too few amplifiers employ push-pull circuits; and there is too little inclination to employ expensive power tubes in the last stages; with the result that we frequently have distortion due to saturation in the transformers, or overloaded tubes somewhere along the line.

MR. GERNSBACK:—That partly answers my next question, which I will put to you if you have something more to say about it, and that is:

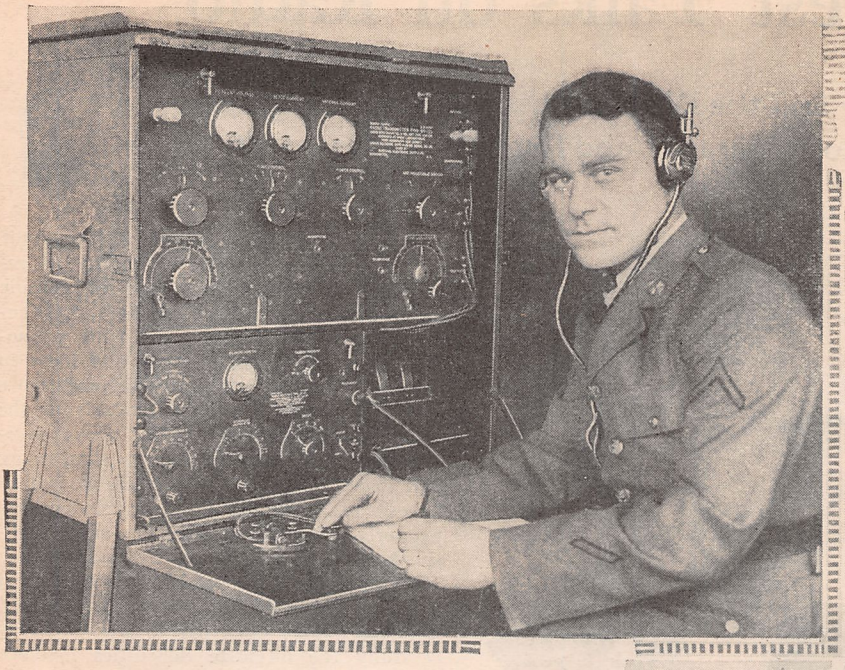
What is lacking to make present day sets more perfect?

DR. DE FOREST:—I think the greatest need in that direction is better audio-frequency

(*Continued on page* 1177)

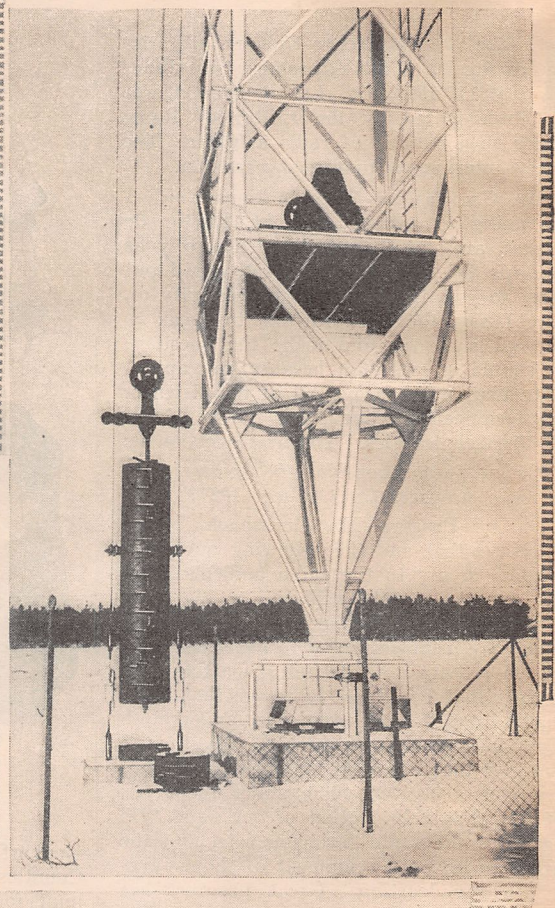
The accompanying lecture was recently given over Station WRNY, New York, during its regular Wednesday evening feature, "The Home Science University."

During this hour, well-known personages in the arts and sciences lecture at WRNY and Mr. Hugo Gernsback, Editor of this publication, conducts an open forum.

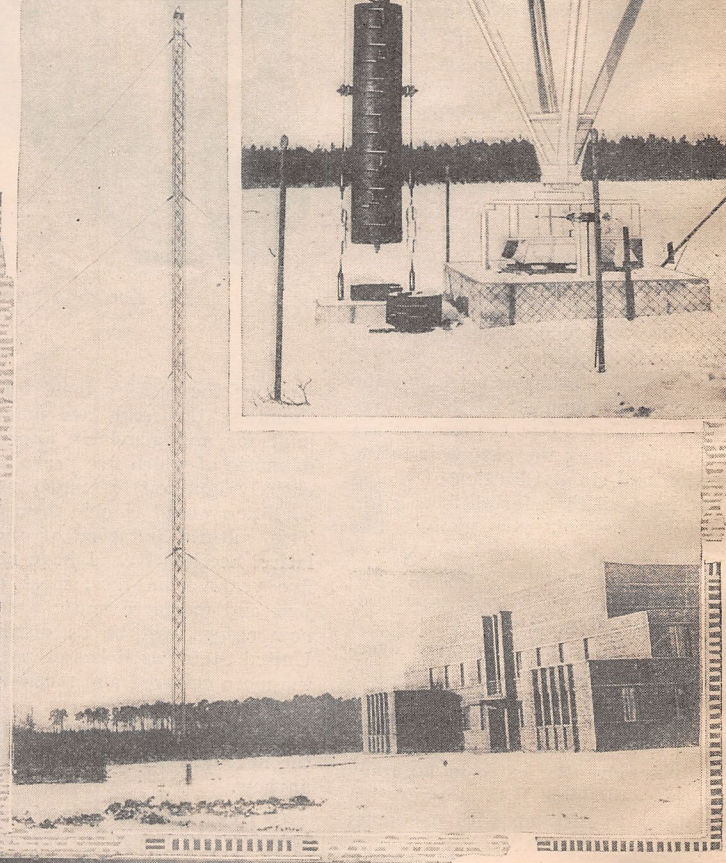


A problem which recently has been solved is that of communicating from any point with an airplane by means of the portable transmitter shown in the above illustration. It has a power rating of 50 watts and can be used for either telegraphy or telephony.
© Underwood & Underwood.

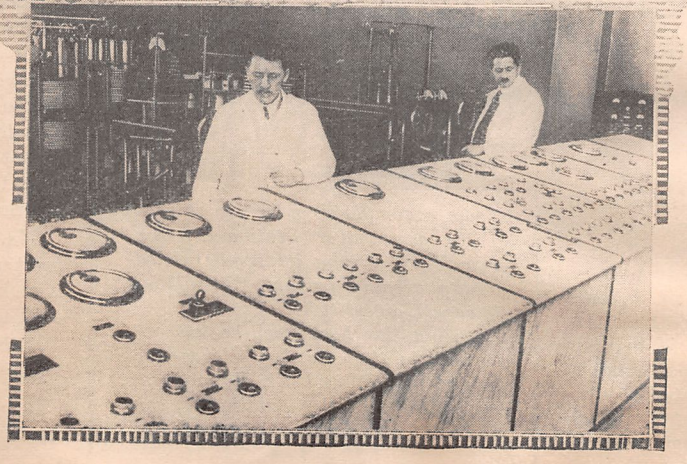
A broadcast station capable of transmitting with a power of 120 kilowatts was opened recently at Zeesen, about 20 miles south of Berlin, Germany. In the illustration below is shown the lower end of one of the aerial towers, and the heavy weight used for maintaining a fixed tension in the wires.
© P. & A.



One of the main troubles experienced when communicating between an airplane and the ground, or between two airplanes in flight, is that an operator in the airplane has trouble in hearing the radio signals in the phones, because of the motor noises. In the illustration above is shown a new helmet, designed for aviators, in which the phones are an integral part of the head covering. The microphone is especially constructed and is strapped to the operator's chest.
© Underwood & Underwood.



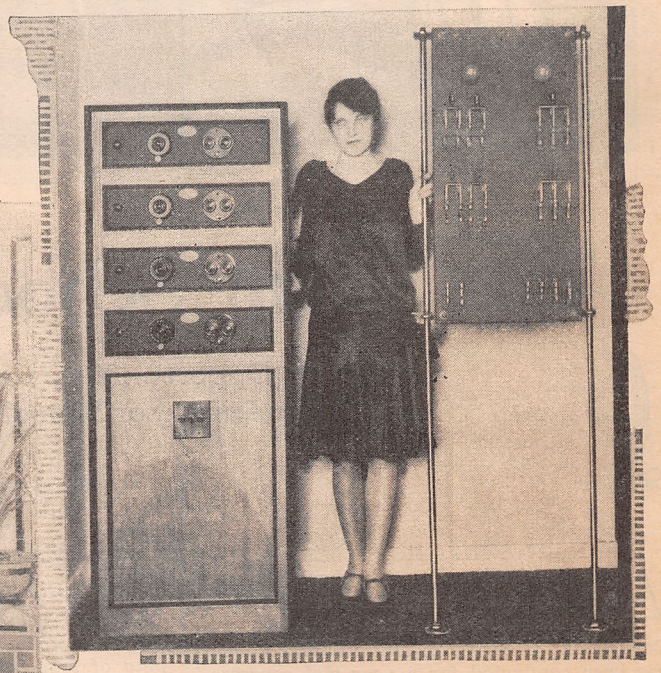
In the illustration above is one of the two 210-meter masts supporting the transmitting aerial at the Zeesen broadcast station; it is designed for a 100-ton strain. The wavelength of the station, which supplants that at Koenigswusterhausen, is 1,250 meters. Notice the modernistic trend of the style of architecture in the station building.
© P. & A. Photo.



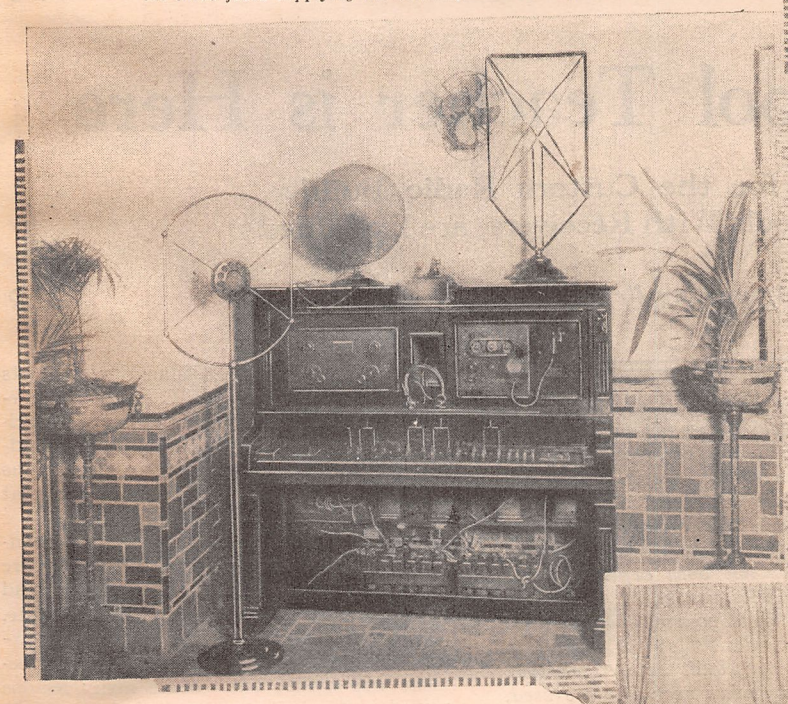
In the illustration at the left is the novel horizontal control board of the Zeesen station; all the operations are controlled from this central point.
© Underwood & Underwood.

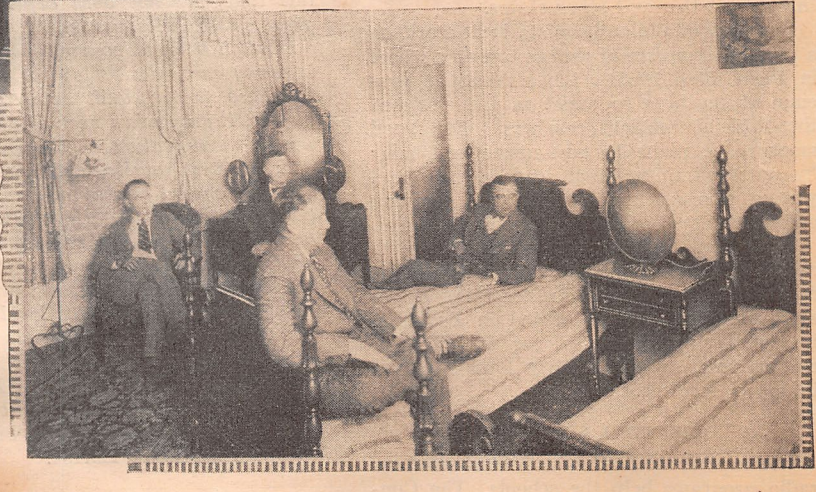
How the headphones are hung over the outlet panel which contains the three jacks supplying the three optional radio programs.

Listening to a radio program in the Robert Morris Hotel, Philadelphia, in which every guest has a choice of three different radio programs.

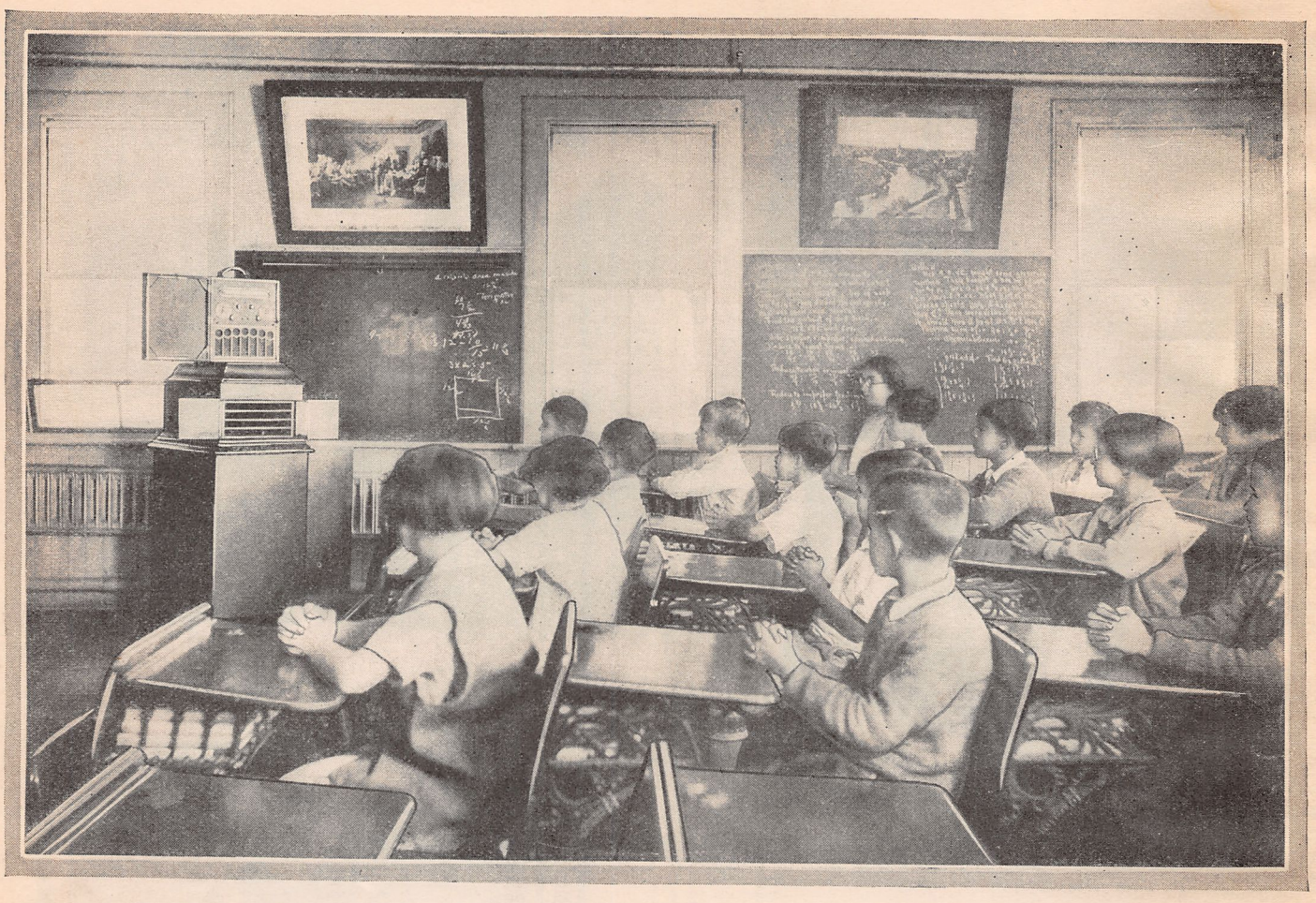


Three antennas are available for these receivers in the Robert Morris Hotel; the fourth set is for emergency use. Special amplifiers are used, so that every guest has clear reception available at good headphone volume.





Above, the radio installation in the Hotel George Washington, Jacksonville, Florida. In every guest room and throughout the lobbies, dining rooms, etc., are loud speakers which bring to the guests the best radio programs of the day. In case special announcements or emergency requests have to be made, the management can get in touch with every guest within a very few seconds. The radio equipment shown above can be used for either reception of programs or general announcing, by the throwing of two or three switches. At the right, one of the rooms, showing the loudspeaker equipment which is provided for the guests who wish entertainment brought to them.



The Radio School Teacher is Here

Further Opportunities for the Custom Radio Builder, in the Equipping of Schools With Receivers, are Explained

By Armstrong Perry

A NATIONAL system is being developed for broadcasting short, superlative radio programs intended especially for schools. Already, in Connecticut, a course in music appreciation has been conducted for a year and courses in trees, geography, children's books, birds, animals, insects and flowers are now being broadcast. They are received in schools throughout this and other states.

A group of philanthropists is at work on a plan to offer free of charge to every school in the United States, the services of preeminent teachers to assist in the work of the faithful resident teachers. For good measure, it plans to add music and talks by outstanding national leaders, men and women who are making history. Leading educators are cooperating in the movement.

With such prospects in view, and with radio receivers available everywhere, it is no wonder that schools are hurrying to install equipment. One located in Brooklyn is considering estimates for installing a master receiver with eighty loud speakers in the classrooms.

CREATING A MARKET

The experience in Connecticut shows how radio programs help the schools. The Connecticut State Board of Education conducts the courses; Station WTIC gives its services. The Connecticut State College of Agriculture was hooked up with WTIC in broadcasting the lessons, as long as money was available to pay for the telephone line that connected it with the studio.

Announcements of the course are broadcast at the beginning of the year, and are sent in printed form to the officials and teachers of the schools throughout the state. There were only half a dozen radio receivers in the schools when the first announcement was made; but, before many lessons were broadcast, it was found that 60 schools had purchased receivers, 35 were renting them and 162 were sending pupils to private homes, where they were invited to listen in.

One enterprising radio dealer installed a receiver in the school in his town, each day when there was a radio lesson, and connected it with loud speakers in seven class rooms. He says that it has proved good advertising. Forty-five superintendents of schools report that pupils in 75 out of the 169 towns under their supervision have received the instruction. The officials at WTIC report that 275,000 pupils in five states heard one lesson in which the Travelers Symphonic Ensemble provided the music. Has any

WE have often pointed out that a good deal of money can be made by custom radio builders, through equipping of schools with special radio sets for educational purposes. As Mr. Perry shows in this article, there is a big market for radio sets which up to this time, has not been exploited; and great possibilities are in it.

Though it is, of course, possible (and in many cases desirable) for schools to purchase factory-built sets, it is true also that, even when such sets are used, power amplification becomes necessary and, for best results, a number of loud speakers should be stationed at different points in the school. Here is where the custom radio builder can do a worthwhile job.

In larger schools, it will be desirable to build a special set for local requirements; particularly where one such set supplies different classrooms, each of which has a loud speaker. It would seem that here is one of the best markets for the custom radio builder at the present time.—EDITOR.

The covers of four books prepared by school children, in which were written their impressions of the musical course broadcast by radio.

other new school method ever made such a gain in its first year?

PUPILS ARE ENTHUSIASTIC

Educators are inclined to conservatism and many of them prefer to follow well-beaten paths, but pupils are eager for new experiences and adventures. Wherever a progressive teacher grasped the possibilities of the course and placed it before a class with reasonable preparation and enthusiasm, it was appreciated. In Pomfret, Connecticut, for example, they could hardly wait for the next program; Pomfret has always been progressive and adventurous, ever since the day when Israel Putnam pulled the wolf out of the cave in that historic town.

The pupils of one school asked if they might make booklets about the radio music course; permission was given and it became an absorbing game. They vied with each other to produce the most attractive designs for the covers; they wrote accounts of the music that they heard and told about the lives of the composers; they illustrated the pages with original drawings or with pictures clipped from newspapers and magazines. They prepared and bound the pages with the greatest care. One little girl rewrote one of her pages four times before it came up to her ideal.

MUSIC COURSE INCREASED INTEREST

The teachers were surprised by unexpected developments; they themselves began to appreciate music as they never had done before. Pupils renewed their interest in class-room work, because the music and the facts concerning it were closely related to other studies. They learned to tell the stories of MacDowell's "Of a Tailor and a Bear," Nevin's "The Rosary," and other songs. That led to development in oral composition. The note books made written composition more interesting. Penmanship improved as each pupil tried to make his book the best. They learned to spell the common words used in music; those which they misspelled were likely to appear in the next day's spelling lesson!

The social studies, history, geography and civics, took on new meaning; because the homes of many of the composers were in places found on the maps and their lives were associated with the history of the United States and many other countries. "The Ballet of the Flowers," "The Pussy Willow Song," "Raindrops," "The Trout," and "The Mouse Trap" connected up with nature study. The course led the pupils to more serious reading, for they wanted to know more about the men who had expressed their thoughts and feelings so beautifully in music. Drawing improved when the note book covers and illustrations were under way. Even arithmetic became more interesting, because the music was written in three-four, four-four and other times and the why of it had to be figured out.

The course increased the use of the phonograph: for, after hearing a musical composition rendered and explained by the radio teacher, it was a delight to hear it again and again on the phonograph in order to catch every phrase and expression.

The most popular lessons were those in which pupils took part. Glee clubs, bands and orchestras from city high schools were heard sometimes in the course. More of them were heard after that through the radio sets at home. It was a great incentive for pupils to learn to play and sing and try to improve, so that they might some day become radio artists instead of mere listeners.

Classical music, which often bores the children of this age of jazz, came to be understood, appreciated, longed for. The course developed a demand for lectures, but that came from teachers—the pupils were almost unanimous in requesting "more music, less talk!" Some, however, said: "We like programs that are like regular lessons."

The effect of the course was not confined to the school room. Pupils went home to tell their parents about the new teacher who talked to them from way over in Hartford, and found that mother had been listening in also. A new bond was created between the school and the home.

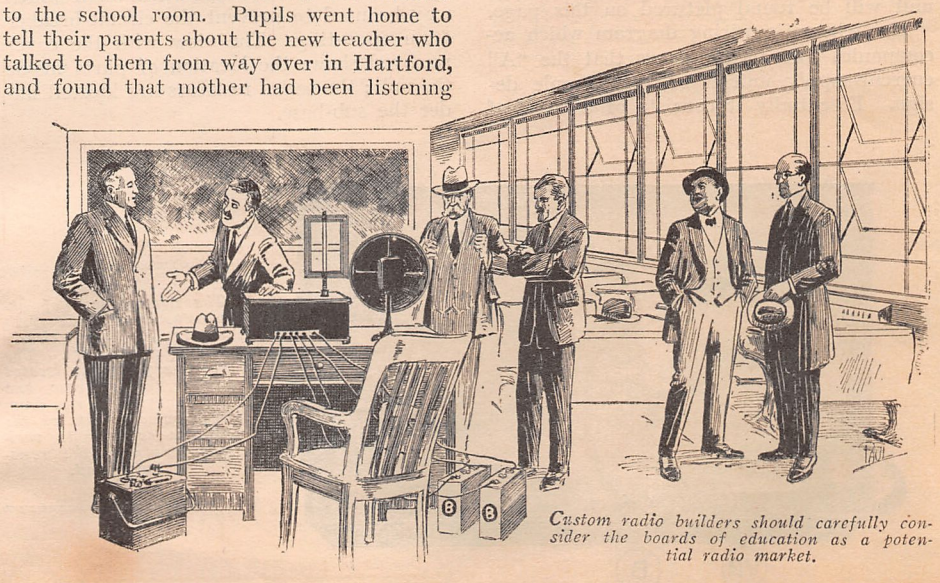
USE OF RADIO BY EDUCATORS INCREASING

The selection of the course in music appreciation, as the first to be offered to the Connecticut schools, was made after careful study. England has a broad curriculum of formal courses of instruction broadcast on a national basis. Atlanta, Oakland and Denver have provided regular courses by radio for several years. Music has been found the best subject to start with.

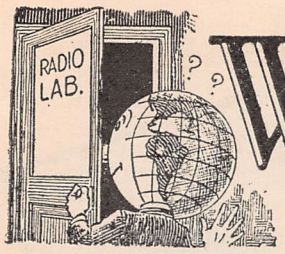
The Connecticut State Board of Education provided its schools with printed syllabi in advance, which gave the educators an opportunity to plan their work. Printed programs were distributed, one for each room in each school, on requisition of the superintendents. That gave each lesson the enjoyable aspect of a concert.

Dr. N. Searle Light, director of the division of rural education, has been placed in charge of the courses, because the need for them seems even greater in the country than in the city. He reports that the first year's experience justifies the continuance and development of instruction by radio. Martin B. Robertson, state supervising agent, says that the course developed appreciation of the best in music, gave an opportunity for the growth of an attitude of careful listening, and enriched material for

(*Continued on page* 1165)



Custom radio builders should carefully consider the boards of education as a potential radio market.



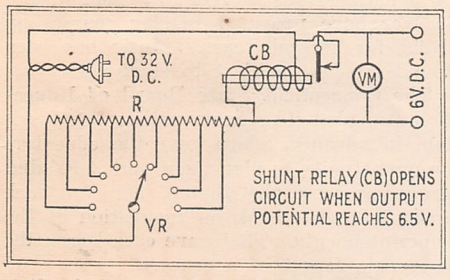
What's New in Radio

Names and addresses of manufacturers of devices described in this department may be obtained by writing to the "I Want to Know" department of RADIO NEWS.

Simple Device Provides "A" Power For Farmers

WHEN designing accessories for radio receivers, a large percentage of the manufacturers in this country have considered only the demands of the broadcast listeners who reside in the cities and towns, and have ignored almost entirely the needs of the farmers, who wish also to enjoy radio programs. In more than nine cases out of ten the socket-power units, chargers, automatic relays, etc., designed for the benefit of the city user are of no value to the farmer whose house is not supplied with electricity from the city power stations.

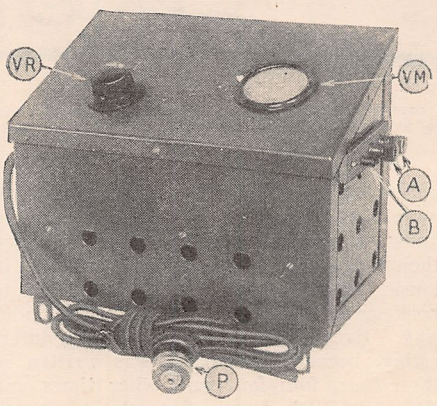
In a large number of modern farm and rural houses electric power is obtained from a 32-volt farm-lighting plant; this consists of a bank of storage batteries, which are



Complete schematic diagram of "A" power unit which operates from a 32-volt D.C. source. R, resistance bank; VR, voltage-regulator; CB, circuit-breaker; VM, voltmeter.

charged each day with current from a small electric generator driven by a gasoline motor. Such an outfit provides an ideal source of filament power for a radio receiver, and recently a manufacturer has placed on the market an "A" current-supply unit which, when connected to a 32-volt D.C. supply, reduces the voltage to the 6 required for operating the average set. The unit will be found pictured on this page.

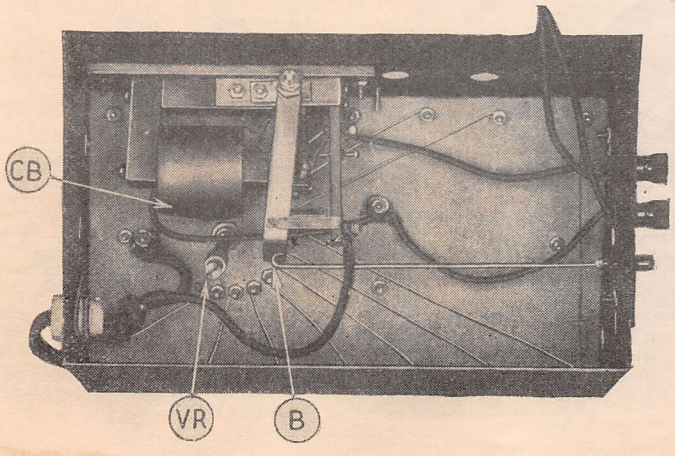
The schematic wiring diagram which accompanies this article shows that the "A" current-supply unit is of very simple design. Essentially it consists of a bank of resistance units, a multi-point switch, a voltmeter and a circuit-breaker. The resistors (R) are connected in series and reduce to a suitable amount the voltage ap-



General view of farm "A" power unit housed in a compact metal case. The knob, VR, adjusts the filament voltage; the voltmeter,, VM, shows the potential at the output binding posts (A); and the knob B may be used to prevent the shunt circuit-breaker from operating.

plied to the filament. The switch (VR) connects various portions of the resistance bank into the circuit and in this way adjusts the output voltage to the required value. The voltmeter (VM) registers accurately the exact voltage at all times; and the circuit-breaker (CB) prevents the possibility of applying accidentally an excessively high voltage to the tubes, as it is so adjusted that it opens the circuit when the potential difference is over 6½ volts between the output terminals.

The entire device is housed in a compact metal case which measures 5x 7¾ x 9¼ inches. The voltage-control knob (VR) and the voltmeter (VM) are mounted on the top. The plug (P) is connected into the 32-volt supply circuit, and the binding posts (A) provide the 6-volt supply to the receiver. B is an adjustment knob which may be used to prevent the circuit-breaker from operating. The view with the cover removed shows the location of parts inside the unit; the series resistors are located under the sub-base.



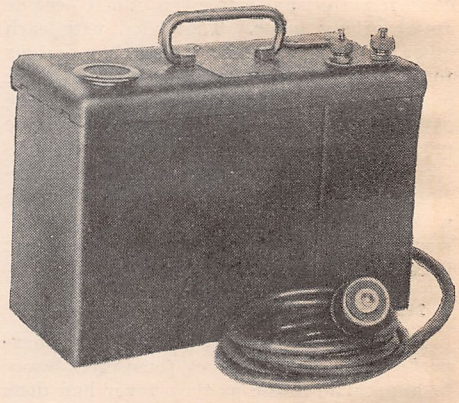
The arrangement of apparatus inside the "A" supply unit is clearly shown at the left. The resistance bank is located under the sub-base and the heavy wires run from the contact points of the voltage-regulator to various points in the resistance unit.

New Socket-Power Unit For Sets Using 199-Type Tubes

THE "A" power unit illustrated on this page was designed especially for use in the battery compartment of a popular superheterodyne receiver, which uses tubes of the 199 type; but it may be employed to advantage for electrifying any receiver using 4-volt dry-cell-type tubes.

A large majority of the receivers using 199-type tubes obtain their filament power from three No. 6 dry-cell batteries connected in series; and these batteries are usually located in the receiver cabinet. Therefore, an "A" power unit for sets of this type should be small in size, in order that it may fit in the space formerly occupied by the batteries. The "A" power unit under discussion answers this requirement. It is housed in a metal case 4 by 9 inches by 6 inches high and weighs only 11½ pounds. It will provide pure direct current of 0.6 amperes at 4 volts, which is ample for the operation of any receiver using 10 tubes or fewer.

There are on the power unit no knobs or dials which require adjustment. Two



This compact unit may be used to provide filament power for sets using up to ten 199-type receiving tubes. It supplies 0.6 amperes at 4 volts D.C.

binding posts are provided, for connecting wires to the battery posts of the set, and there is a filler hole where distilled water is added at rare intervals; in addition, there is the wire and plug which connects with the lamp socket. To install the unit it is necessary only to connect two wires to the posts and insert the plug in the socket. After it has been installed it is necessary to add water to the filler hole on an average of only once every six months. It should also be remembered that the unit is turned on and off at the lamp socket and *not* by the filament switch on the panel of the receiving set.

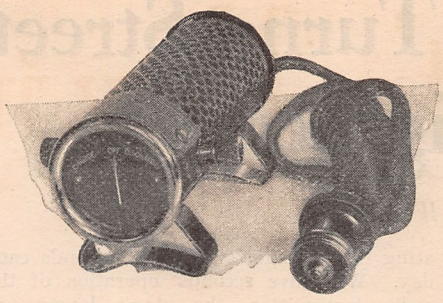
Electrically, the unit consists of a step-down transformer, a rectifier of the electrolytic type, and a filter system consisting of a heavy-duty choke coil and a high-

capacity electrolytic condenser bank. Power units of this type, which were designed to supply filament current to receivers using 6-volt tubes, have been described previously in this department. Those who are interested in a more technical explanation of the action of the electrolytic rectifier and condenser bank should refer to articles which were published in the December 1927 and February 1928 issues of RADIO NEWS. Although the devices described in these articles are different in external appearance and larger in size, they operate on identical electrical principles and are of similar construction.

It should be explained that this unit does not supersede *all* batteries. It provides filament power for 4-volt tubes and replaces the "A" battery; but "B" batteries or a "B" power unit are still required. It should also be pointed out that the unit may be operated only with 110-volt, 60-cycle house current.

New Trickle Charger For Use In D. C. Circuits

Many different types of trickle chargers have been developed for operation from 110-volt, alternating-current house-lighting circuits, and these units have become very popular among set owners who wish to electrify their receivers at a low cost. However, few trickle chargers have been designed for use in direct-current circuits. As the public utilities, in a number of the large cities in this country, including New York City, furnish homes with direct current, there is a demand for such a device.



A compact trickle-charger unit for operation in 110-volt D.C. circuits.

The accompanying illustration shows a simple, efficient direct-current trickle charger. It may be used to charge storage "A" or "B" batteries direct from a 110-125-volt direct-current line. It will charge from one to forty lead-battery cells at one time and the rate of charge is between 0.1 and 0.3 amperes, depending upon the number of cells in the series connection. A standard 6-volt storage battery, of the type used for radio purposes, is charged at a rate of approximately 0.3 amperes.

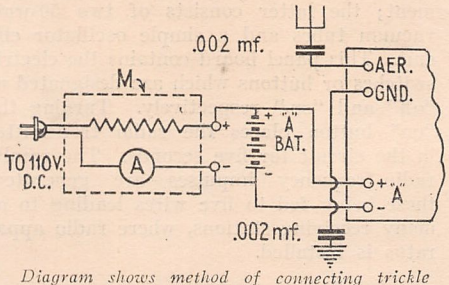


Diagram shows method of connecting trickle charger (M) to a radio set when batteries are used for the "B" supply.

The construction of the unit is very simple. It consists of a fixed resistor and an ammeter, connected in series with the battery and 110-volt D.C. line. The ammeter is of the "charge—off—discharge" type and is used to indicate whether the charger is correctly connected. The resistor is wire-wound, vitreous-enameled and will not burn out when operated under the conditions described above. The unit is enclosed in a cylindrical metal case, 6 inches long and 2¼ inches in diameter, which stands on legs one inch high.

There are several precautions, which must be taken in connection with operating direct-current trickle chargers. As one of the mains carrying direct current is connected to the ground, it is necessary to place in series with the ground lead of the radio set a condenser between .002- and 0.5-mf. capacity, to prevent a short circuit of the 110-volt line. It is wise, also, to connect a similar condenser in the antenna circuit. If "B" batteries are used for the operation of the receiver, the trickle charger may be connected as illustrated in the diagram. However, if the receiver is operated with a "B" socket-power unit, it is necessary to disconnect the trickle charger from the house-current supply, by means of a *double-pole* switch, when the set is being used.

When connecting the charger with the house current for the first time, it is important to make sure that the plug is inserted in the light socket in such a way that

(*Continued on page* 1184)

$100.00 Monthly Prize for Set Builders

IN conjunction with the change of policy editorially announced in this issue, RADIO NEWS, during 1928, will offer a monthly prize of $100.00 to radio constructors, set builders and custom radio builders for the best practicable radio circuit or constructional development of the month.

The idea of this prize is to encourage constructors in building. The prize is not given for all radio sets or hook-ups, or all power packs and other constructional articles, that are accepted for publication. Prizes will only be given on those published in our so-called "Blueprint Articles," where full constructional details are given.

If you have experimented with a new circuit—if you have made an important improvement on a known circuit—if you have designed a new power pack—and providing the material is acceptable, RADIO NEWS will publish the article and pay $100.00 for the best one submitted.

It should be understood, that we are not interested in mere circuits or mere ideas. If you wish to enter into the monthly contest, it is necessary that you must give some evidence that you have actually built and tested the new feature. It is necessary that, with your first letter, photographs should be submitted, showing what work has been performed. If the editors are sufficiently impressed with the novelty of the idea, they will do in their discretion one of two things: RADIO NEWS will either build the circuit or power pack, whichever it may be, in its own laboratories, or will call upon you to send the model to New York for test.

In any event, RADIO NEWS reserves for itself the right, when accepting the article, to substitute and specify other apparatus, leaving the selection to the editors, if such should be advisable; but the main features of the design as recommended by the constructor will always remain intact.

All radio manufacturers are excluded from the contest, as it is designed only for the encouragement of constructors and radio builders.

In the past, RADIO NEWS has been responsible for the publication of many important circuits; just to mention a few, the Ultradyne, the Tropadyne, the Interflex Series, the Strobodyne, the Peridyne and many others. RADIO NEWS desires the best and latest, and is willing to pay for it.

Furthermore, in many instances, the builder has made capital from his circuit. In a recent circuit published in RADIO NEWS (the Super-Hilodyne) the inventor, Mr. Jewell, was paid a very large sum for his novel circuit. It was first published exclusively in RADIO NEWS.

Furthermore, as an added incentive to the constructor, providing also the circuit is patentable, RADIO NEWS hereby agrees to take out a patent in the inventor's name, paying the entire patent fees; and when a patent is issued, it will, of course, belong to the inventor in whose name it is taken out. Do not, under any circumstances, send sets to RADIO NEWS without having first obtained the consent of RADIO NEWS. Kindly read the following conditions carefully and you will see what is wanted:

CONDITIONS AND RULES OF THE MONTHLY RADIO NEWS BUILDERS' COMPETITION

1. RADIO NEWS desires all new or novel circuits, power packs, amplifier combinations, television sets, etc.

2. No one shall be eligible for a prize unless some experimental work, showing the practicability of the device, has been demonstrated by the builder.

3. Photographs evidencing proof of the above must be sent with the article first to RADIO NEWS. If the article is accepted, RADIO NEWS will either send for the device, paying transportation therefor, or build the device in its own laboratory, in its discretion.

4. Parts used may either be standard parts obtainable on the market, or they may be home-made. The designer must submit a complete wiring diagram, drawn in ink on white paper, also sketches showing the outstanding features of the device in general. Articles giving complete constructional and detailed information to be sent at the same time.

5. Bundle all papers firmly together so they cannot be separated, and note that on each sheet and photograph, entrant's name and address must be clearly printed. No penciled matter considered. Use typewriter or pen and ink. Rolled manuscripts are excluded from the contest. Use wherever possible, photo-mailers which are obtainable at all stationery stores.

6. The monthly competition closes on the fifteenth of every month. From the contest are excluded all radio manufacturers, as well as the employees of the Experimenter Publishing Company and their families.

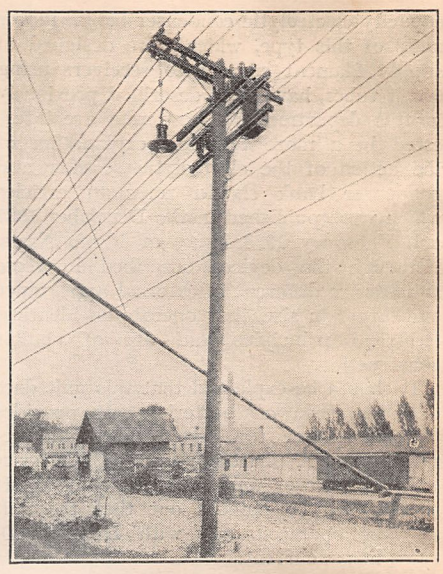
Address all entries to Editor, Monthly Construction Feature, c/o RADIO NEWS, 230 Fifth Avenue, New York City.

When Radio Turns Street Lamplighter

By S. R. Winters

EXPERIMENTALLY, a scientist in Washington, D. C., has opened the door of his automobile garage by means of radio. On a railway train in France the stations are announced by the use of electromagnetic waves. Various cities are employing broadcasting and receiving equipment in issuing orders to their police forces. Hundreds of radio fans are using their receiving sets in conjunction with clocks as alarm systems to wake their families in the mornings. An automobile traffic count has been made by virtue of radio apparatus. And, now, the street lights of an entire town are turned on and off through the magic of the wonderful radio waves.

A vacuum-tube transmitting set, using a small amount of power and operating on a wavelength of 7,500 meters, and five receiving sets responding to only one wavelength, control the street-lighting system of Glens Falls, New York. Street lamplighters in that town, like a buggy-whip socket on an automobile, are now out of date. A low-powered tube transmitter, not very dissimilar to the transmitting sets that bring music and speech to our homes, feeds a carrier-current or radio-frequency wave along wires leading to the receiving stations. There radio receivers tuned to that single wavelength, or frequency, respond to the radio wave and, in turn, electric switches are tripped, relays operated, and street lamps lighted.

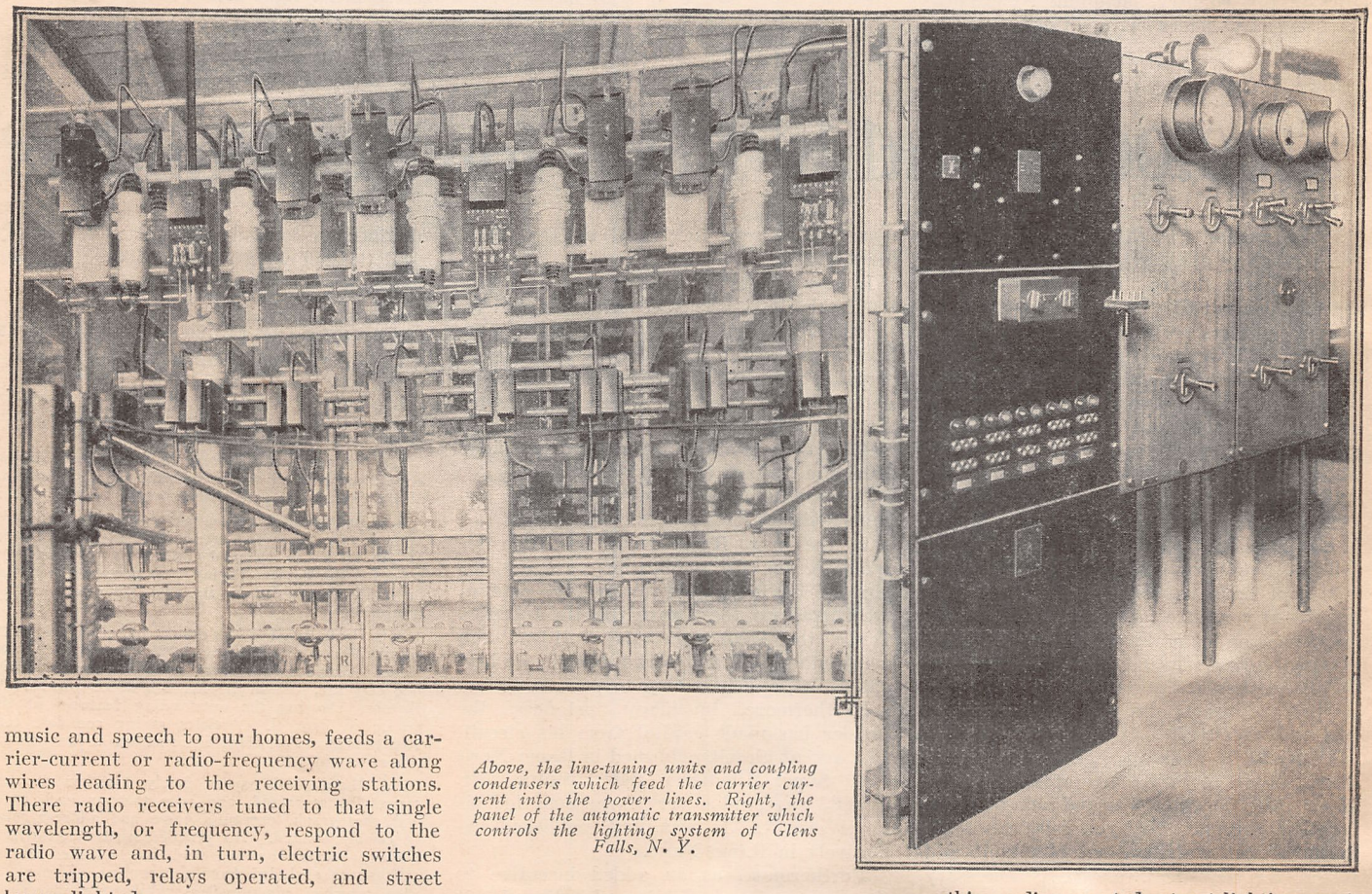


One of the automatic receivers which governs a lighting district is contained in the box on the pole.

QUICK WORK

This radio system does not disperse waves in all directions, but concentrates its force along the electric-power wires and thereby a whole town can be illuminated by operating the transmitter only 15 seconds each day. With five seconds' operation of the radio transmitter, the street lamps are lighted; when the operator twists the "off" button in the power house the radio transmitting set operates automatically for ten seconds and the lights are simultaneously cut off. The feeder or electric-power lines extend to five different sections of Glens Falls and, although each section or unit is independent of the other, the entire town's thousand street lamps are controlled by virtue of the carrier-current system.

This wired radio system involves the use in the powerhouse of a small panel board holding all of the radio transmitting equipment; the latter consists of two 50-watt vacuum tubes and a simple oscillator circuit. This panel board contains the electric switches or buttons which are designated as "off" and "on," respectively. Turning the "on" button places the radio transmitter in the circuit for five seconds. The result: radio-frequency impulses are generated, these being fed to five wires leading to as many receiving stations, where radio apparatus is installed.



Above, the line-tuning units and coupling condensers which feed the carrier current into the power lines. Right, the panel of the automatic transmitter which controls the lighting system of Glens Falls, N. Y.

NIGHT AND MORNING WORK

The five receiving sets, one in each of the five sections of the town's street-lighting system, control the relay circuits to complete the lighting-current supply. Transformers in each of the five independent units of the lighting system step down the potential in the feeder wires to the desired lighting voltage—110—and the street lamps are then lighted. At daybreak the operator at the powerhouse turns the "off" button on the radio-transmitter panel and the radio waves—in this case "wired wireless"—again pass over the feeder wires; they are picked up by the radio receiving sets and the relays, and, at the proper instant, the street lights are turned off.

Each of the receiving sets employed in this radio-operated street-lighting system contains one vacuum tube, relays, transformers, and other necessary units for the reception of radio impulses and for actuating the control circuit. The tube used in each receiver is operated below its rating and has an anticipated life of twelve

(*Continued on page* 1161)

List of Broadcast Stations in the United States

Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
KDKA	East Pittsburgh, Pa. .	**316	50000
(Also 62.5, 42.95, and 27 meters and other short-wave transmissions on varying power.)			
KDLR	Devils Lake, N. D.	231	15
KDYL	Salt Lake City, Utah. .	234	500
KELW	Burbank, Calif.	229	*500
KEX	Portland, Ore.	240	2500
KFAB	Lincoln, Neb.	319	5000
KFAD	Phoenix, Ariz.	273	500
KFAU	Boise, Idaho	285	*2000
KFBB	Havre, Mont.	275	100
KFBC	San Diego, Calif. (Also 65.18 meters)	248	100
KFBI	(airplane) Calif.	204	50
KFBK	Sacramento, Calif.	535	100
KFBL	Everett, Wash.	224	50
KFBU	Laramie, Wyo.	484	500
KFCB	Phoenix, Ariz.	*244	125
KFCR	Santa Barbara, Calif.	211	50
KFDM	Beaumont, Texas	484	500
KFDX	Shreveport, La.	236	250
KFDY	Brookings, S. D.	545	500
KFDZ	Minneapolis, Minn.	216	10
KFEC	Portland, Ore.	214	50
KFEL	Denver, Colo.	248	250
KFEQ	St. Joseph, Mo.	231	1000
KFEY	Kellogg, Idaho	232	10
KFGQ	Boone, Iowa	210	10
KFH	Wichita, Kan.	246	500
KFHA	Gunnison, Colo.	254	50
KFHL	Oskaloosa, Iowa	213	10
KFI	Los Angeles, Calif.	468	5000
KFIF	Portland, Ore.	214	50
KFIO	Spokane, Wash.	246	100
KFIU	Juneau, Alaska	225	10
KFIZ	Fond du Lac, Wis.	**268	100
KFJB	Marshalltown, Iowa	248	*100
KFJF	Oklahoma City, Okla.	273	*750
KFJI	Astoria, Ore.	250	15
KFJM	Grand Forks, N. D.	333	100
KFJR	Portland, Ore.	283	100
KFJY	Fort Dodge, Iowa	232	100
KFJZ	Fort Worth, Texas	250	50
KFKA	Greeley, Colo.	250	200
KFKB	Milford, Kansas	242	*1500
KFKU	Lawrence, Kansas	254	500
KFKX	Chicago, Ill.	526	2500
KFKZ	Kirksville, Missouri	225	15
KFLV	Rockford, Ill.	268	100
KFLX	Galveston, Texas	270	100
KFMR	Sioux City, Iowa	232	100
KFMX	Northfield, Minn.	236	500
KFNF	Shenandoah, Iowa (day)	461	2000
KFOA	Seattle, Wash.	447	1000
KFON	Long Beach, Calif.	242	500
KFOR	Lincoln, Neb.	217	100
KFOX	Omaha, Neb.	258	100
KFPL	Dublin, Texas	275	15
KFPM	Greenville, Texas	231	15
KFPR	Los Angeles, Calif.	232	250
KFPW	Carterville, Mo.	263	50
KFPY	Spokane, Wash. (7XAB. 105.9 meters, 50 watts)	246	250
KFQA	St. Louis, Mo.	234	50
KFQB	Fort Worth, Texas	333	1000
KFQD	Anchorage, Alaska	345	100
KFQU	Holy City, Calif. (Also 31, 53, 63, 106 meters, 50 watts)	250	100
KFQW	Wenatchee, Wash.	217	100
KFQZ	Hollywood, Calif. (Also 108.2 meters, 50 watts)	232	100
KFRC	San Francisco, Calf.	454	1000
KFRU	Columbia, Missouri	250	500
KFSD	San Diego, Calif.	441	500
KFSG	Los Angeles, Calif. (Has short-wave transmitter)	275	500
KFUL	Galveston, Texas	258	500
KFUM	Colorado Spgs., Colo.	283	1000
KFUO	†Clayton, Mo.	545	*1000
KFUP	Denver, Colo.	227	100
KFUR	†Farmington, Utah.	225	500
KFUS	Oakland, Calif.	256	50
KFUT	Salt Lake City, Utah.	250	50
KFVD	Venice, Calif. (Also 105 meters, 50 watts)	213	250
KFVG	Independence, Kan.	225	50
KFVI	Houston, Texas	238	50
KFVS	Cape Girardeau, Mo.	**224	50
KFWB	Los Angeles, Calif. (Also 105 and 40 meters, 50 watts)	361	100
KFWC	Glendora, Calif.	222	100
KFWF	St. Louis, Mo.	214	250
KFWI	San Francisco, Cal.	268	500
KFWM	Oakland, Calif.	236	*500
KFWO	Avalon, Calif.	300	250
KFXD	Jerome, Idaho	204	15
KFXF	Denver, Colo.	283	250
KFXJ	†Edgewater, Colo. (near)	216	500
KFXR	Oklahoma City, Okla.	224	50
KFXY	Flagstaff, Ariz.	205	25
KFYO	Breckenridge, Tex.	211	15
KFYR	Bismarck, No. Dak.	250	*250
KGA	Spokane, Wash.	261	2000
KGAR	Tucson, Ariz.	234	100
KGBU	Ketchikan, Alaska	400	500
KGBX	St. Joseph, Mo.	288	100
KGBY	Columbus, Nebraska	222	50
KGBZ	York, Nebraska	213	100
KGCA	Decorah, Iowa	248	10
KGCB	Oklahoma City, Okla.	216	50
KGCH	Wayne, Nebraska	294	250
KGCI	San Antonio, Texas	220	100
KGCL	Seattle, Wash.	231	50
KGCN	Concordia, Kansas	208	50
KGCR	Brookings, So. Dak.	208	15
KGCU	Mandan, No. Dak.	240	100
KGCX	Vida, Montana	244	10
KGDA	Dell Rapids, So. Dak. (daytime)	254	15
KGDE	Barrett, Minn.	205	50
KGDM	Stockton, Calif.	217	10
KGDP	Pueblo, Colo.	224	10
KGDR	San Antonio, Texas	207	15
KGDW	Humboldt, Neb.	294	100
KGDY	Oldham, So. Dak.	207	15
KGEF	Los Angeles, Calif.	263	500
KGEH	Eugene, Ore.	201	50
KGEK	Yuma, Colo.	263	10
KGEN	El Centro, Calif.	225	15
KGEO	Grand Island, Neb.	205	100
KGEQ	Minneapolis, Minn.	204	50
KGER	Long Beach, Calif.	216	100
KGES	Central City, Neb.	204	10
KGEW	Fort Morgan, Colo.	219	*100
KGEY	†Denver, Colo.	201	250
KGEZ	Kalispell, Montana	294	100
KGFB	Iowa City, Iowa	224	10
KGFF	Alva, Oklahoma	205	25
KGFG	Oklahoma City, Okla.	216	50
KGFH	La Crescenta, Calif.	224	250
KGFI	San Angelo, Texas	220	15
KGFJ	Los Angeles, Calif.	213	100
KGFK	Hallock, Minn.	224	50
KGFL	Raton, N. M.	222	50
KGFN	Aneta, No. Dak.	200	15
KGFO	Los Angeles, Cal. (port.)	204	100
KGFW	Ravenna, Neb.	297	10
KGFX	Pierre, S. D. (day)	254	200
KGGF	Pichér, Okla.	207	100
KGGH	Cedar Grove, La.	213	50
KGGM	Inglewood, Calif. (port.) (6XAI, 66.04 meters; 50 watts)	204	100
KGHB	Honolulu, Hawaii	227	250
KGHC	Slayton, Minn.	210	15
KGHF	Pueblo, Colo.	210	250
KGHP	Hardin, Mont.	263	50
KGO	Oakland, Calif. (Short-wave transmitter, 10 to 40 meters, 10,000 watts)	**384	5000
KGRC	San Antonio, Texas	220	100
KGRS	Amarillo, Texas	244	*250
KGTT	San Francisco, Calif.	207	50
KGU	Honolulu, Hawaii	270	600
KGW	Portland, Oregon	492	1000
KGY	Lacey, Wash.	244	50
KHJ	Los Angeles, Calif. (Also 104.1 meters; 50 watts)	400	1000
KHMC	Harlingen, Tex.	236	100
KHQ	Spokane, Wash.	370	1000
KICK	Red Oak, Iowa (day)	322	100
KJBS	San Francisco, Calif. (6XAR, 33 meters; 50 watts)	220	50
KJR	Seattle, Wash. (Also 105.2 meters; 5 to 250 watts)	349	2500
KKP	Seattle, Wash.	265	15
KLCN	Blytheville, Ark. (day)	285	50
KLDS	Independence, Mo.	270	1500
KLIT	Portland, Ore.	207	10
KLS	Oakland, Calif.	246	250
KLX	Oakland, Calif.	508	500
KLZ	†Dupont, Colo.	353	*750
KMA	Shenandoah, Iowa.	395	1000
KMBC	see KLDS		
KMED	Medford, Oregon	250	50
KMIC	Inglewood, Calif.	224	250
KMJ	Fresno, Calif.	266	50
KMMJ	Clay Center, Neb.	285	*250
KMO	Tacoma, Wash.	254	250
KMOX	†St. Louis, Mo.	300	5000
KMTR	Los Angeles, Calif. (Also 108.2 meters; 250 watts)	526	500
KNRC	Santa Monica, Calif. (Also 108.2 meters; 100 watts)	375	500
KNX	Los Angeles, Calif. (Also 107.1 meters; 100 watts)	337	500
KOA	Denver, Colo.	**326	*2500
KOAC	Corvallis, Oregon	270	500
KOB	State College, New Mex	395	*5000
KOCH	Omaha, Neb.	258	250
KOCW	Chickasha, Okla.	252	250
KOIL	Council Bluffs, Iowa. (9XU, 61.06 meters, 500 watts)	319	5000
KOIN	†Portland, Oregon.	319	1000
KOMO	Seattle, Wash.	306	1000
KOW	Denver, Colo.	248	250
KPCB	Seattle, Wash.	231	50
KPJM	Prescott, Ariz.	214	15
KPLA	Los Angeles, Calif.	252	500
KPNP	Muscatine, Iowa	211	100
KPO	San Francisco, Calif.	422	1000
KPPC	Pasadena, Calif.	229	50
KPRC	Houston, Texas	294	500
KPSN	Pasadena, Calif.	316	1000
KQV	Pittsburgh, Pa.	270	500
KQW	San Jose, Calif.	297	500
KRAC	Shreveport, La.	220	50
KRE	Berkeley, Calif.	256	100
KRLD	Dallas, Texas	461	500
KRLO	Los Angeles, Calif. (6XAN, 105.9 meters, 250 watts)	216	250
KRSC	Seattle, Wash.	211	50
KSAC	Manhattan, Kansas	333	500
KSBA	†Shreveport, La.	268	1000
KSCJ	Sioux City, Iowa	244	*500
KSD	St. Louis, Mo.	545	500
KSEI	Pocatello, Idaho	333	250
KSL	Salt Lake City, Utah	303	1000
KSMR	Santa Maria, Calif.	273	100
KSO	Clarinda, Iowa.	227	500
KSOO	Sioux Falls, So. Dak.	210	*250
KSTP	St. Paul, Minn.	222	*2000
KTAB	Oakland, Calif.	280	500
KTAP	San Antonio, Texas	229	20
KTBI	Los Angeles, Calif.	288	500
KTBR	Portland, Oregon.	283	50
KTHS	Hot Springs, Ark.	**384	*1000
KTNT	Muscatine, Iowa.	256	2000
KTSA	San Antonio, Texas.	265	2000
KTUE	Houston, Texas	213	5
KTW	Seattle, Wash.	395	1000
KUJ	Seattle, Wash.	200	10
KUOA	Fayetteville, Ark.	297	500
KUOM	Missoula, Mont.	461	500
KUSD	Vermillion, So. Dak.	484	250
KUT	Austin, Texas.	232	500
KVI	Tacoma, Wash.	234	50
KVL	Seattle, Wash.	203	100
KVOO	Tulsa, Okla.	349	1000
KVOS	Bellingham, Wash.	210	50
KWBS	Portland, Oregon.	200	15
KWCR	Cedar Rapids, Iowa.	240	250
KWEA	Shreveport, La.	213	250
KWG	Stockton, Calif.	345	50
KWJJ	Portland, Ore. (Also 53. 54 meters, 100 watts)	229	50
KWK	St. Louis, Mo.	234	*1000
KWKC	Kansas City, Mo.	222	100
KWKH	Shreveport, La.	395	1000
KWLC	Decorah, Iowa	248	50
KWSC	Pullman, Wash.	395	500
KWTC	Santa Ana, Calif.	222	100
KWUC	LeMars, Iowa (day).	**244	1500
KWWG	Brownsville, Texas.	278	500
KXA	Seattle, Wash.	349	500
KXL	Portland, Ore.	220	50
KXRO	Aberdeen, Wash.	227	50
KYA	San Francisco, Calif.	309	500
KYW	Chicago, Ill.	526	*2500
KZM	Oakland, Calif.	246	100
NAA	Arlington, Virginia.	**434	1000
WAAD	Cincinnati, O.	268	25
WAAF	Chicago, Ill. (portable)	389	500
WAAM	Newark, N. J. (Also 65.18 meters, 50 watts)	268	250
WAAT	Jersey City, N. J.	246	300
WAAW	Omaha, Neb. (daytime)	441	500
WABC	Richmond Hill, N. Y. (Also 64.0 meters, 500 watts)	309	*2500
WABF	Pringleboro, Pa.	205	250
WABI	Bangor, Me. (Sundays)	389	100
WABO	See WHEC		
WABW	Wooster, Ohio.	248	50
WABY	Philadelphia, Pa.	248	50
WABZ	New Orleans, La.	238	50
WADC	Akron, Ohio.	238	1000
WAFD	Detroit, Mich.	231	100
WAGM	Royal Oak, Mich.	225	50
WAIT	Taunton, Mass.	214	10
WAIU	†Columbus, Ohio.	283	5000
WAIZ	Appleton, Wis.	227	100
WALK	Willow Grove, Pa.	201	50
WAMD	†Minneapolis, Minn.	222	1000
WAPI	Auburn, Ala.	341	1000
WASH	Grand Rapids, Mich.	256	250
WATT	Boston, Mass (portable)	201	100
WBAA	West Lafayette, Ind.	**273	500
WBAK	Harrisburg, Pa. (day).	300	500
WBAL	†Baltimore, Md.	**285	5000
WBAO	Decatur, Ill.	268	100
WBAP	Fort Worth, Texas.	500	5000
WBAW	Nashville, Tenn.	240	500
WBAX	Wilkes Barre, Pa.	250	100
WBBC	Brooklyn, N. Y.	227	500
WBBL	Richmond, Va.	234	100
WBBM	†Glenview, Ill.	**389	5000
WBBP	Petoskey, Mich.	240	100
WBBR	Rossville, N. Y.	256	1000
WBBW	Norfolk, Va.	236	100
WBBY	Charleston, So. Car.	250	75
WBBZ	Chicago, Ill. (portable)	204	100
WBCN	Chicago, Ill.	288	250
WBES	Takoma Park, Md.	265	100
WBET	Medford, Mass.	288	500
WBIS	See WNAC		
WBKN	Brooklyn, N. Y.	200	100
WBMH	Detroit, Mich.	211	100
WBMS	Union City, N. J.	200	100
WBNY	New York, N. Y.	236	500
WBOQ	Richmond Hill, N. Y.	309	500
WBRC	Birmingham, Ala.	242	250
WBRE	Wilkes Barre, Pa.	250	100
WBRL	Tilton, N. H. (1XY, 105, 109 meters, 250 watts)	232	500
WBRS	See WCDA		
WBSO	Wellesley Hills, Mass.	384	100
WBT	Charlotte, No. Car.	258	*750
WBZ	†Springfield, Mass. (Has short-wave transmitter)	*333	15,000
WBZA	Boston, Mass.	*333	500
WCAC	Mansfield, Conn.	535	500
WCAD	Canton, N. Y.	244	*500
WCAE	Pittsburgh, Pa.	461	500
WCAH	Columbus, Ohio.	234	250
WCAJ	Lincoln, Neb. (day)	380	500
WCAL	Northfield, Minn.	286	500
WCAM	Camden, N. J.	224	500
WCAO	Baltimore, Md.	244	250
WCAP	Asbury Park, N.J.	240	500
WCAT	Rapid City, So. Dak.	248	100
WCAU	Philadelphia, Pa.	261	500
WCAX	Burlington, Vermont.	254	100
WCAZ	Carthage, Ill.	250	50
WCBA	Allentown, Pa.	222	100
WCBD	Zion, Ill.	345	5000
WCBE	New Orleans, La.	227	5
WCBM	Baltimore, Md.	225	100
WCBR	Providence, R.I. (port.)	201	100
WCBS	Springfield, Ill.	210	250
WCCO	†Minneapolis, Minn.	**405	*5000
WCDA-WBRS	Cliffside, N. J.	211	250
WCFL	Chicago, Ill.	484	1500
WCGU	Brooklyn, N. Y. Also 54 meters, 150 watts)	219	500
WCLO	Kenosha, Wisc.	227	100
WCLS	Joliet, Ill.	216	500
WCMA	Culver, Ind.	261	500
WCOA	Pensacola, Fla.	250	500
WCOC	Columbus, Miss.	231	250
WCOT	†Olneyville, R. I.	225	100
WCRW	Chicago, Ill.	224	500
WCSH	Portland, Maine. (Also 63.79 meters, 250 watts)	366	500
WCSO	Springfield, Ohio.	256	500
WCWK	Fort Wayne, Ind.	214	250
WCWS	Danbury, Conn.	265	100
WCX	See WJR		
WDAD	See WLAC		0
WDAE	Tampa, Fla.	268	500
WDAF	Kansas City, Mo.	370	1000
WDAG	Amarillo, Texas	263	250
WDAH	El Paso, Texas.	234	100
WDAY	Fargo, No. Dakota	545	*750
WDBJ	Roanoke, Va.	231	250
WDBO	Orlando, Fla. (4XE, variable, 250 watts)	288	*500
WDEL	Wilmington, Del.	297	100
WDGY	Minneapolis, Minn.	275	500
WDOD	Chattanooga, Tenn.	244	500
WDRC	New Haven, Conn.	283	500
WDWF-WLSI	New Bedford, Mass.	261	250
WDZ	Tuscola, Ill. (daytime)	278	100
WEAF	†Bellmore, N. Y.	**492	50,000
WEAM	North Plainfield, N. J.	263	250
WEAN	Providence, R. I.	275	500
WEAO	Columbus, Ohio. (Also 54.02 meters, 250 watts)	283	750
WEAR	Cleveland, Ohio.	**400	1000
WEBC	Superior, Wis.	242	*250
WEBE	Cambridge, Ohio	248	10
WEBH	Chicago, Ill.	366	*500
WEBJ	New York, N. Y.	**256	500
WEBQ	Harrisburg, Ill.	224	15
WEBR	Buffalo, N. Y.	242	500
WEBW	Beloit, Wis.	258	500
WEDC	Chicago, Ill.	242	500
WEEI	Boston, Mass. (Has short-wave transmitter)	508	500
WEHS	Evanston, Ill.	216	100
WEMC	Berrien Spgs., Mich.	484	1000
WENR	Chicago, Ill.	288	500
WEPS	Gloucester, Mass.	297	100
WEVD	Woodhaven, N. Y.	246	500
WEW	St. Louis, Mo. (day)	353	1000
WFAA	Dallas, Texas	545	500
WFAM	St. Cloud, Minn.	252	10
WFAN	Philadelphia, Pa.	224	500
WFBC	Knoxville, Tenn.	234	50
WFBE	Cincinnati, Ohio.	246	250
WFBG	Altoona, Pa.	268	100
WFBJ	Collegeville, Minn.	273	100
WFBL	Syracuse, N. Y.	258	750
WFBM	Indianapolis, Ind	275	1000
WFBR	Baltimore, Md.	244	100
WFBZ	Galesburg, Ill.	248	50
WFCI	Pawtucket, R. I.	242	100
WFDF	Flint, Mich	273	100
WFI	Philadelphia, Pa	405	500
WFIW	Hopkinsville, Ken	261	750
WFJC	Akron, Ohio.	227	500
WFKB	Chicago, Ill.	224	500
WFKD	Philadelphia, Pa.	248	50
WFLA	Clearwater, Fla.	517	750
WGAL	Lancaster, Pa.	252	15
WGBB	Freeport, N. Y.	246	400
WGBC	Memphis, Tenn.	229	15
WGBF	Evansville, Ind.	236	250
WGBI	Scranton, Pa.	231	250
WGBS	†New York, N. Y.	349	500
WGCP	Newark, N. J.	268	250
WGES	†Chicago, Ill.	242	500
WGHP	†Mt. Clemens, Mich.	278	750
WGL	†Secaucus, N. J.	294	1000
WGM	Jeannette, Pa.	208	50
WGMS	Minneapolis, Minn.	246	500
WGMU	New York, N.Y. (port.) (Also 106 meters, 50 watts)	201	100
WGN-WLIB	Chicago and Elgin, Ill.	416	15,000
WGOP	Flushing, N. Y.	200	100
WGR	Buffalo, N. Y.	303	750
WGST	Atlanta, Ga.	270	500
WGY	Schenectady, N. Y. (Also on 32.77, 21.96 and sometimes 5 meters)	**380	50,000
WHA	Madison, Wisc.	333	750
WHAD	Milwaukee, Wisc.	270	500
WHAM	Rochester, N. Y. (Has short-wave transmitter)	*280	5000
WHAP	†Carlstadt, N. J.	236	1000
WHAS	Louisville, Ky.	322	500
WHAZ	Troy, N. Y. (Monday)	306	500
WHB	Kansas City, Mo.	341	500
WHBA	Oil City, Pa.	261	10
WHBC	Canton, Ohio.	236	10
WHBD	Bellefontaine, O.	222	100
WHBF	Rock Island, Ill.	222	100
WHBL	Chicago, Ill. (portable)	204	100
WHBM	Chicago, Ill. (portable)	201	100
WHBP	Johnstown, Pa.	229	*250
WHBQ	Memphis, Tenn.	232	100
WHBU	Anderson, Ind.	220	15
WHBW	Philadelphia, Pa.	220	100
WHBY	West De Pere, Wis.	250	50
WHDI	Minneapolis, Minn.	246	500
WHEC-WABO	Rochester, N. Y.	254	500
WHFC	Chicago, Ill.	216	200
WHK	Cleveland, Ohio. (Also 66.04 meters, 500 watts)	**265	*500
WHN	New York, N. Y.	395	500
WHO	Des Moines, Iowa	535	5000
WHPP	Englewood, N. J.	205	10
WHT	†Chicago, Ill.	306	5000
WIAD	Philadelphia, Pa.	288	100
WIAS	Ottumwa, Iowa (day)	322	100
WIBA	Madison, Wis.	240	100
WIBG	Elkins Pk., Pa. (Sund'ys)	441	50
WIBJ	Chicago, Ill. (port.)	201	100
WIBM	Chicago, Ill. (port.)	201	100
WIBO	†Chicago, Ill.	306	5000
WIBR	Steubenville, Ohio.	250	50
WIBS	Elizabeth, N. J.	204	250
WIBU	Poynette, Wis.	217	20
WIBW	Topeka, Kan.	204	250
WIBX	Utica, N. Y.	238	*150
WIBZ	Montgomery, Ala.	231	15
WICC	Easton, Conn.	265	500
WIL	St. Louis, Mo.	258	250
WIOD	Miami Beach, Fla.	248	1000
WIP	Philadelphia, Pa.	349	500
WISN	Milwaukee, Wis.	270	250
WIVA	Norfolk, Va.	210	100
WJAD	Waco, Tex.	333	500
WJAG	Norfolk, Neb.	285	*250
WJAK	Kokomo, Ind.	234	50
WJAM	Cedar Rapids, Iowa.	240	250
WJAR	Providence, R. I.	484	500
WJAS	Pittsburgh, Pa.	270	500
WJAX	Jacksonville, Fla.	341	1000
WJAY	Cleveland, Ohio.	227	500
WJAZ	†Mt Prospect, Ill.	263	5000
WJBA	Joliet, Ill.	248	50
WJBB	Sarasota, Fla.	238	250
WJBC	LaSalle, Ill.	227	100
WJBI	Red Bank, N. J.	263	250
WJBK	Ypsilanti, Mich.	220	15
WJBL	Decatur, Ill.	213	250
WJBO	New Orleans, La.	263	100
WJBT	Chicago, Ill.	389	500

THE list of broadcast stations here presented is in accordance with the temporary licenses issued by the Radio Commission; and subject to the possibility of minor adjustments being made by that authority, will remain in force until April 1, 1928.

*Allowed higher daylight power, **Standard or constant-frequency transmission. †Remote Control.

(*Continued on page 1147*)

"Weighing In" Radio Stations

A Description of Easily-Constructed Apparatus That Will Tune in Different Radio Stations by the Addition of Weights on a Balance

By A. Binneweg, Jr.

THE Marconi of our college was Philip Randall; he was a young man, not over twenty-five years of age, who had recently received his E.E. degree. He had been promised the first vacant assistant-professorship in the electrical department and, while waiting for this opening, he had accepted the position of laboratory assistant. He was kept very busy with his official duties during the day but, frequently after dinner, he would retire to a corner of the laboratory and experiment with new radio apparatus of his own invention. Often a light would be noticed in the laboratory during the early hours of the morning and everyone knew that Randall was occupied in perfecting some new radio device.

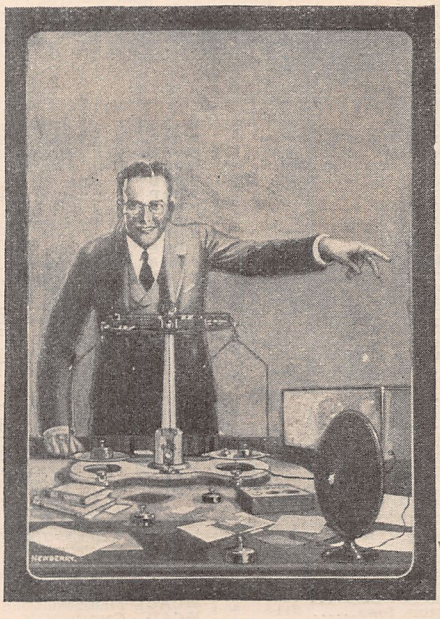
From our brief description of Philip Randall, we do not wish you to gain the impression that he was eccentric; for he was not. Randall was well-liked among the students of the college and was popular also with the fair sex. On the nights when special dances were held he was always to be found in the crowd, and he was present at all athletic events of importance. Participation in the rehearsals of the glee club was another college activity which he enjoyed greatly. However, he had always saved at least three or four evenings each week for experimenting in the laboratory, and during the course of a year he would develop many very interesting receivers.

THE PLOT THICKENS

It so happened that, for over a month prior to the Easter vacation, Randall appeared to be very busy with his radio experiments, and most of his associates accused him of being unduly secretive. It was noticed that he had not been present at three consecutive meetings of the glee club and that he had left the Saturday evening dance before 11 o'clock. In addition to these suspicious circumstances, a light was seen burning in the laboratory every evening.

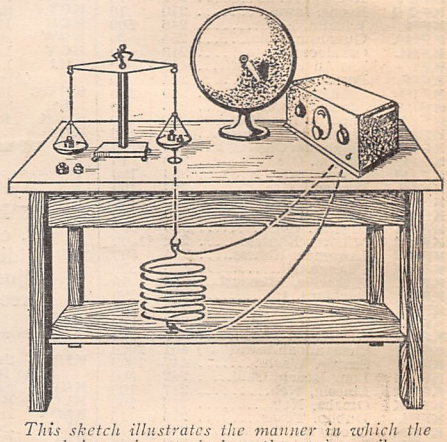
Usually, when busy with his experiments in the laboratory, Randall would welcome the company of students, who were interested in his work, as often they would be able to assist him and check his results. During the period we are describing, he acted peculiarly, in this respect also; when anyone would enter the laboratory he would quickly cover up his work and plainly show that he did not desire company. When questioned about his work he would avoid giving any details, but promised to give a demonstration of his invention when it was complete.

A few days before the Easter vacation a complete change came over Randall. He seemed anxious to join everyone in having a good time and was glad to be included in all social activities. He accepted several invitations to parties and surprised all by inviting a number of students to a party at his home during the coming week.



"Randall selected a weight, placed it on the scale . . . and the signals were heard coming from the speaker."

Everyone was in the best of spirits on the evening of Randall's party. Six men who were particularly interested in radio had been invited and they were accompanied by an equal number of girls from the city itself. In the early part of the evening they played bridge; later the tables were removed and they danced to the tunes of an electric phonograph; and, around 10:30 P. M., refreshments were served. After all had finished eating it was suggested that radio music would finish up the evening in great style. This, it seemed, was exactly what Randall had been waiting for; as he stood up in preparation for making a speech.



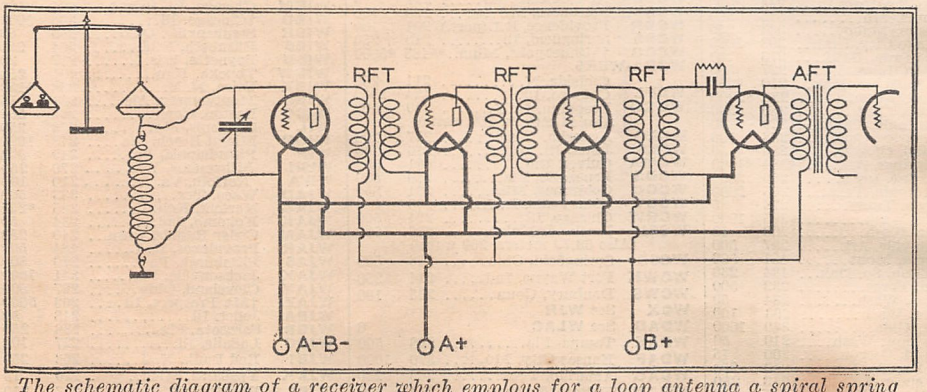
This sketch illustrates the manner in which the balance is attached to the spring coil.

A REMARKABLE DISCOVERY

"Ladies and gentlemen," he began, "for the past several weeks I have been spending all my spare time on a new invention which may revolutionize the entire radio industry, and tonight I will demonstrate to you a remarkable receiver which exemplifies my new deas. In my experimenting I have found that there is a distinct relationship between wavelength and weight, and, with the data which have been discovered after hundreds of tests, I have been able to develop an entirely new system of tuning. With this receiver, a different weight is used for tuning in each station. When this method is used the owner does not have to learn the technique of tuning, but has merely to select a weight which is marked with the call letters of the station he wishes to hear. This weight will automatically tune in the program. Now, gentlemen, if you will assist me, I will remove the set from the closet."

When the closet door was opened all persons in the room could see the apparatus which was to be used in the demonstration. There was a large table and over it a cover which extended almost to the floor. On one end of the table there was a small radio

(*Continued on page* 1159)



The schematic diagram of a receiver which employs for a loop antenna a spiral spring which is tuned by its stretching under the strain of different weights.

Whispering Across the Hudson River

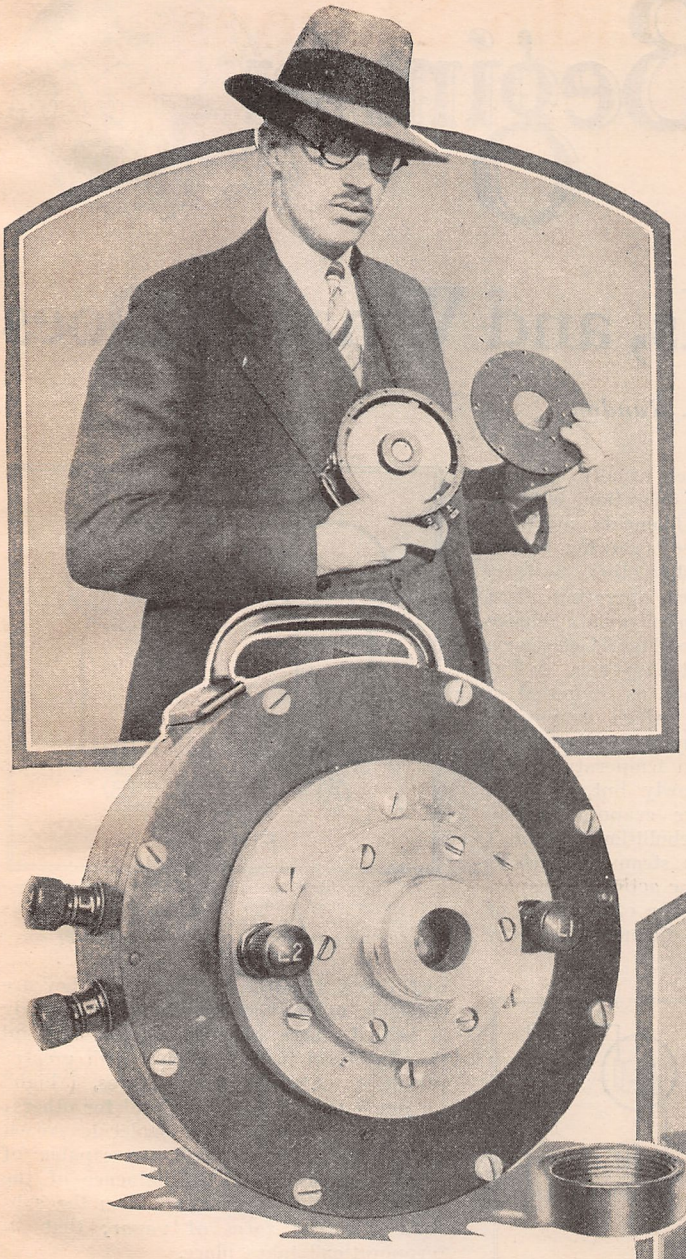
A Loud Speaker with 30-Watt Distortionless Output, which Can be Heard Over a Distance of a Mile

By Joseph Riley

At the left the top plates of the unit have been removed, showing its interior. Below, right, the diaphragm and coil of the speaker; the detached coil shows the method of winding the fine aluminum strip. Insulation is provided by a layer of varnish, .0002-inch thick. The proximity of the coil to the pole pieces has a beneficial cooling action.

ONE of the most rigorous tests to which a loud speaker has ever been subjected was recently performed in New York City by engineers of the Bell Telephone Laboratories, when they installed a giant speaker on the roof of a thirteen-story building on the New York side of the Hudson River for direct communication with the Jersey shore, which is over a mile distant. Engineers on the opposite side of the water heard both music and voice reproduced with enormous volume, but without distortion.

(*Continued on page* 1167)



Above, the completely-assembled loud-speaker unit; two of the binding posts are connected to the moving coil and the other pair to the ends of the electromagnet's windings.

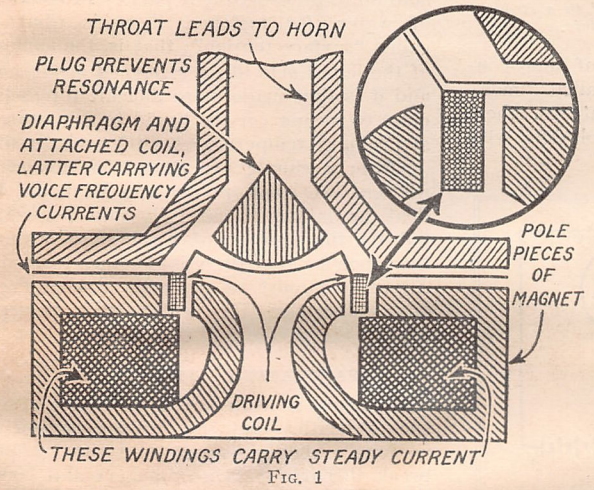
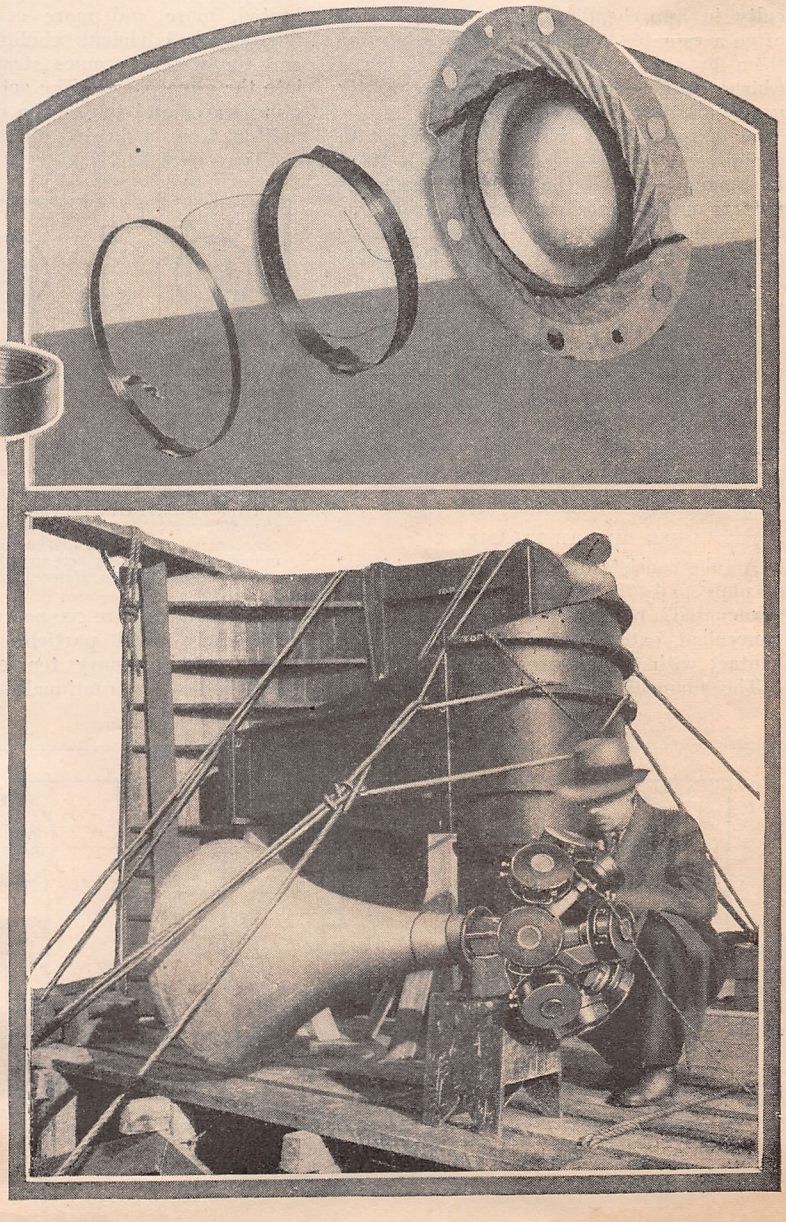

THROAT LEADS TO HORN
PLUG PREVENTS RESONANCE
DIAPHRAGM AND ATTACHED COIL, LATTER CARRYING VOICE FREQUENCY CURRENTS
POLE PIECES OF MAGNET
DRIVING COIL
THESE WINDINGS CARRY STEADY CURRENT

FIG. 1

Above is diagramed the assembly of the new loud-speaker unit; the diaphragm with its attached coil works like the plunger of a pump, at high (audio) frequencies.



At the right, the two horns used in the tests across the Hudson River; nine units were used on the smaller one. Both are of the exponential type, giving maximum range and quality to the transmission of sounds.

What a Radio Tube Is, and What It Does

By Clyde A. Randon

A THOROUGH understanding of the functions of the vacuum tube, the heart of broadcast transmitting and receiving apparatus, is of fundamental importance to the radio beginner if he wishes to understand even the most elementary principles under which his equipment operates. Articles explaining the action of these tubes have been published many times in this and other magazines; but they have been usually so technical that the ordinary listeners, the rank and file of the vast audience which now enjoys the pleasure of radio entertainment, find considerable difficulty in apprehending the meaning. Too often a valuable article is made puzzling for them by the presence of electrical terms which, though elementary, are not frequently used in ordinary conversation.

In this article the writer will attempt to explain the operation of a vacuum tube, in language which the average reader is able to understand; and he will avoid, as far as possible, the special terms used by scientists. Of course, it will be impossible to explain here some of the more complicated applications of radio tubes, as these require a fundamental knowledge of radio circuits in order to learn what takes place; but the way in which a tube functions as an *amplifier* will be described. This is the use of the majority of tubes in radio receivers and, therefore, this explanation should clear up many problems which perplex the mind of the beginner.

USE OF THE FILAMENT

A tube consists of a filament, a grid and a plate, all "hermetically" sealed in an "evacuated" bulb, which is provided with convenient external terminals for making contact with these three "elements" inside.

The filament is simply a thin wire of special composition which usually becomes "incandescent" when in operation, but not necessarily so. Some filaments must be heated to incandescence (glowing whiteness) for best results, while others perform more satisfactorily when operating at a cherry-red heat; different filaments require different temperatures for highest efficiency, but all operate in a similar manner. A filament may be looked upon as composed of a "volatile" substance, which evaporates when heated and thus gradually disappears. Water at ordinary room temperatures, for example, evaporates slowly but, as it is heated, more and more evaporates; and finally there is violent "ebullition" (boiling) and the water becomes steam and passes into the atmosphere. The action of evaporating water and the escape of particles of matter from a heated filament are very similar. (See Fig. 1.)

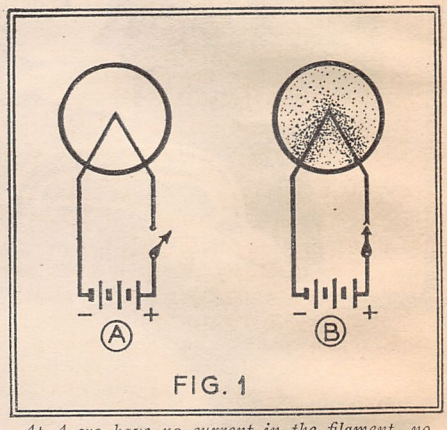


FIG. 1

At A we have no current in the filament, no electrons evaporating. At B, with the battery switch closed, the filament is lighted and from it electrons in countless billions are escaping.

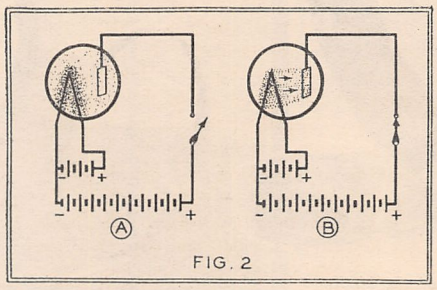


FIG. 2

At A, the "B" battery switch is open, and the electrons gathered in an aimless crowd around the filament. At B the plate is POSITIVELY *charged by connection to the "+" of the "B" battery, and electrons are attracted in a steady stream from filament to plate.*

All substances are composed of almost inconceivably small particles called "molecules." At ordinary temperatures, these small bodies are continually colliding with each other, and in a liquid or gas they are traveling in random directions. If a body is heated, these molecules speed up and thus bombard their neighbors with greater velocities. At high temperatures, ("high" for one substance may be "low" for others; this is only relative) the molecules reach such velocities that some are capable of breaking away from the influence of the others, and thus pass away from the substance, in the form of *vapor;* that is, "evaporation" takes place.

Due to the influence of neighboring molecules, there is a tendency on the part of a solid or liquid substance to "cohere," or hold on to its constituent parts. In the case of water, for instance, there is what is called "surface tension"; that is, the surface of the liquid acts like a *stretched membrane* and it is thus made more difficult for molecules to escape (or the liquid to evaporate) at ordinary temperatures. (One can easily perform a simple experiment in this connection. A small needle can be made to float by laying it carefully and perfectly flat on the surface of a glass of water; thus showing that there is "surface tension." The needle must be perfectly dry or even oily; otherwise the water will "creep" around the needle and it will sink.)

"EVAPORATING" THE FILAMENT

If water is heated, the molecules reach such velocities that the surface tension is no longer strong enough, and they simply break through in large numbers and leave the liquid—as we have explained, *evaporate.* This is almost exactly what takes place in a heated filament. At high temperatures (very much greater than the boiling-point of water, of course) the velocity of the "electrons" or particles of *negative* elec-

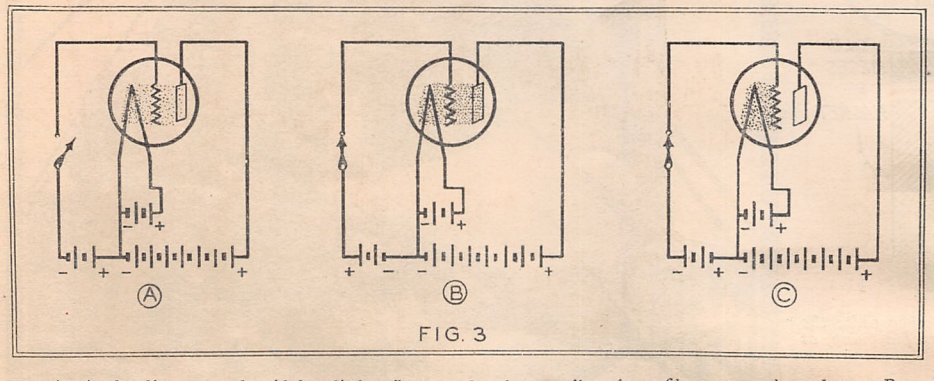


FIG. 3

At A, the disconnected grid has little effect on the electron flow from filament to plate; but at B the "+" charge on the grid adds attraction and greatly increases the flow. On the contrary, the "—" charge on the grid, shown at C, will drive back the electrons and let few or none reach the plate.

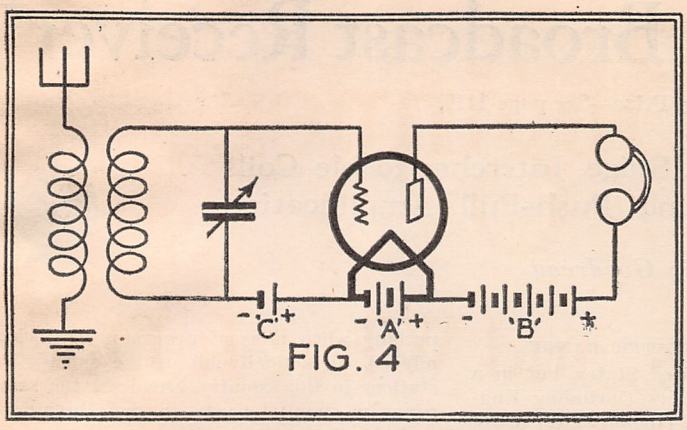


FIG. 4

This diagram shows the simplest way to "hook up" a tube to make a radio receiver. The "A" battery lights the filament; the "B" battery "puts volts on" the plate and causes a flow of current, the changes in which are heard in the phones as sounds. The "C" battery puts on the grid the voltage, commonly called a "bias," which is needed because this tube must be a "detector" (see page 1151) as well as an "amplifier." A pictorial diagram of this one-tube set will be found on page 1168.

tricity in the filament becomes so great that they simply shoot out into the surrounding space, with relatively large velocities.

If another element (such as the "plate," found in all radio vacuum tubes) were placed around the filament, but *insulated* from it, some of these electrons would strike the plate; the rest would tend to form a "cloud" around the filament, some electrons leaving the filament and others again entering it. (This "space-charge" effect is illustrated, and explained, on page 846 of Radio News for February, if any readers desire to follow it further.) A condition approaching *equilibrium* would be reached; that is, there would be the same number of electrons leaving the filament as returning, and no useful result would occur. (See Fig. 2.)

If, however, a *positive* charge (compared with that on the filament) or voltage is placed on the plate, electrons will flow to the plate and continue to do so as long as the filament is heated and the positive charge maintained; since electrons constitute *negative* electricity, they are attracted by a positive voltage (for *unlike* electrical charges attract each other.)

THE ELECTRON STREAM

In the vacuum tube, when connected in this way, there would thus be a *continuous flow of electrons,* and this constitutes an electric "current." It is to be noted that such a stream can proceed in only one direction, from filament to plate—negative to positive. It is often said that the current travels from positive to negative, and this is because in the early days the scientists had their choice of two guesses and they guessed wrong. To this day, this erroneous assumption is still prevalent, in common speech, just as we say "the sun rises;" but if the reader will remember that *the electrons proceed from filament to plate,* there need be no confusion in his mind.

THE ELECTRON-CONTROL GRID

By introducing a third element, called for short a "grid," the stream of electrons between plate and filament can be *controlled.* The grid consists only of very fine wires, spaced at definite distances apart so that a large proportion of the electrons can pass between them. Just as the positive charge on the plate tends to cause a flow of electrons from the filament, so a *positive charge on the grid will also tend to increase this flow.* (See Fig. 3.)

The grid, however, is much nearer to the filament than the plate is; and any charge or "voltage" on the grid will thus have a much greater effect on the electron flow than an equal charge on the plate. A *negative* charge on the grid will decrease the electron flow to the plate (the "plate current") and the amount of decrease will depend upon the strength of the charge on the grid.

It is readily seen, therefore, that the grid acts as a delicate control of the plate current. Since a very small charge on the grid has a relatively large effect on the plate current, the tube "amplifies" the small electrical impulses which are "impressed" on the grid. Very small effects thus give large response.

USE IN A RECEIVER

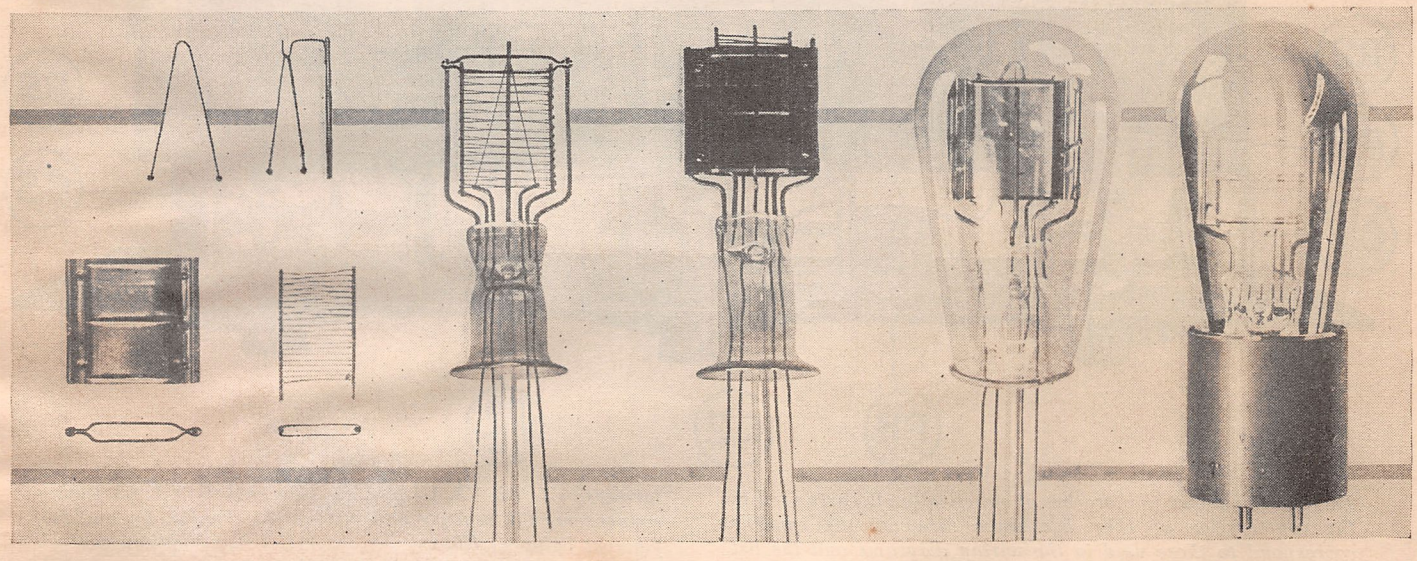
In the simple circuit shown in the diagrams, the tube is used to amplify the weak "signal" impulses which arrive from a broadcast station. A passing wave *induces* a small current in the antenna and this flows through the coil between the aerial and ground. (Note that the current *oscillates* [reverses its direction, back and forth] between the aerial and ground and, therefore, for best results the ground connection must be well-designed also). The current in the primary coil gives rise to a *magnetic field,* which induces another current in the secondary. This gives rise to a difference

(*Continued on page* 1168)

FREE
Blueprints

BEGINNING with this notice, Radio News will give away, free, complete blueprints for sets described in the constructional articles that will be printed in its pages, beginning with the April issue. Blueprints of sets published previous to the April issue are not offered free.

Under the new policy of Radio News, no manufacturers' names nor trade marks are given in the text pages of Radio News. For the information of those who wish to construct sets and power packs, however, and to facilitate their work, the blueprints will contain complete specifications of all the material which is used in making the complete apparatus described in the constructional article. These blueprints will be given free to readers who apply in person at the office of Radio News, between the hours of 9:00 a. m. and 5:30 p. m., daily. Those who apply by mail should enclose ten cents, for postage and mailing only. Address Blueprint Department, Radio News, 230 Fifth Avenue, New York City.



Above we have several of the steps in the assembly of a vacuum tube. At the left: above, the filament; below, the plate and the grid. The four following views show successive stages of manufacture.

An R. F. Short-Wave Broadcast Receiver*

(Awarded $100.00 Monthly Prize—See page 1119)

Incorporating an Optional R. F. Stage, Interchangeable Coils for the 10-725-meter Bands, and Push-Pull Amplification

By W. Francis Goodreau

WAVELENGTHS below 200 meters are rapidly becoming established as channels for the broadcasting of radio entertainment. The recent announcements of the decision of a number of popular broadcast stations to operate special transmitters on these waves proves that the industry's growing faith in transmission on high frequencies is beginning to be manifest in a concrete form. On the other hand, the interest of the general public in the construction of short-wave receivers shows that the special programs which are being transmitted on waves outside the broadcast band are being appreciated.

Short waves have many advantages, from the viewpoints of both the broadcaster and the listener. In the first place, they seem to be more efficient, as the programs of low-power stations are frequently heard half-way around the world. Secondly, there is less congestion, as more individual channels are available; and, as a result, a listener may often receive the program from the short-wave transmitter of a station with less interference than would be experienced in receiving the same program broadcast on the regular waves.

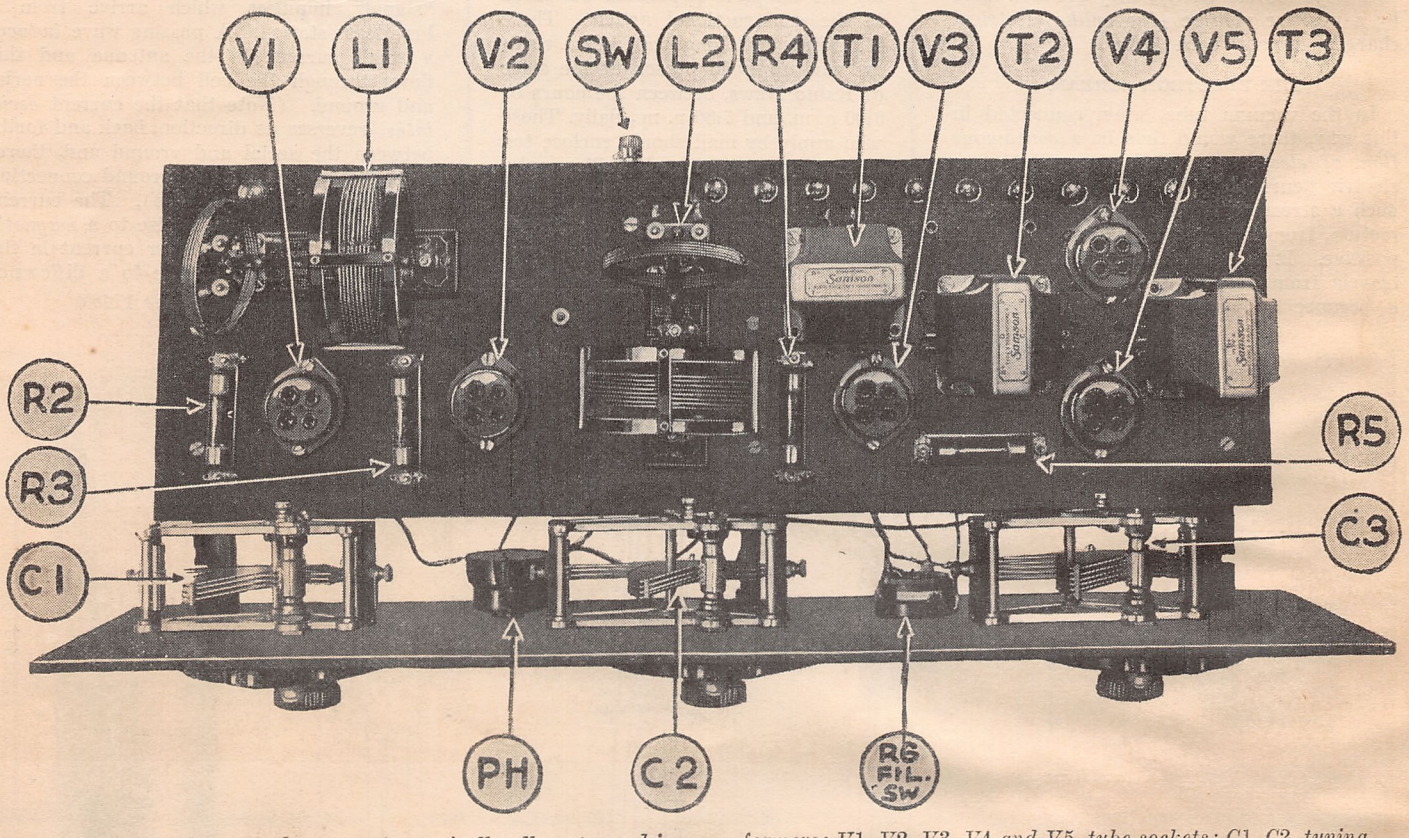
ENORMOUSLY GREATER RANGE

Not only in the United States, but in a number of other countries (including England, France, Germany, Holland, etc.) many stations are broadcasting on waves between 30 and 200 meters. A majority of these programs, even those originating on the other side of the Atlantic, are available to the owner of an efficient short-wave receiver. A number of these stations are broadcasting on regular schedules, while a great number are "on the air" quite frequently, especially when unusual programs are being offered. Practically all of the short-wave stations in this country broadcast the same program simultaneously on their broadcast and short-wave transmitters.

BECAUSE of the demands of readers for the constructional article on a short-wave receiver which it contained, the issue of Radio News *for October, 1927 has been completely exhausted. To satisfy the many people who want to get into the short-wave "game," we are presenting herewith a second article describing another short-wave receiver of excellent design. We earnestly recommend it to our readers who wish something new.*—Editor.

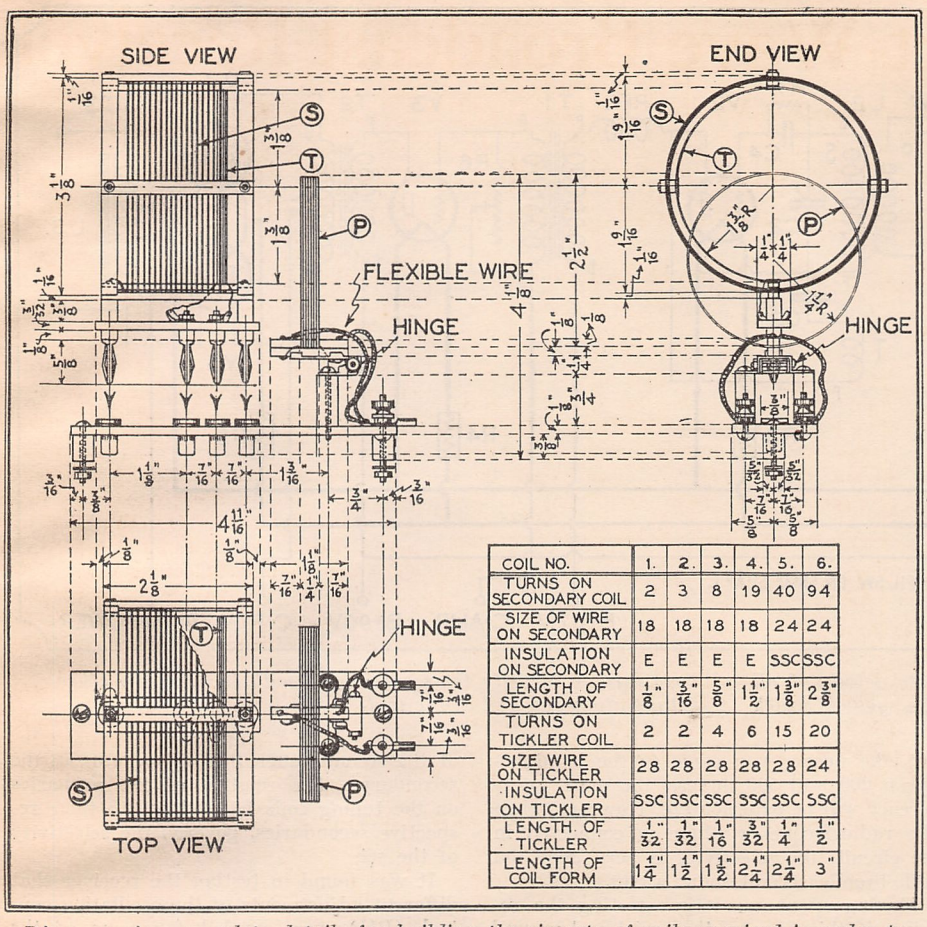
Because of their musical excellence, these programs are interesting to every listener, and especially to the DX fan who, having received practically all of the American and Canadian stations, is looking for new worlds to conquer. Unfortunately, until recently it was not possible to hear the short-wave broadcasts with any degree of satisfaction, because of the lack of suitable receivers. The sets that were used were mostly designed for code reception and, although they were very efficient, they were not designed to give the quality of reception demanded of broadcast receivers to-day.

Recently, however, articles have appeared in a number of radio magazines describing the construction of sets designed for quality of tone reception on short waves. Most strictly-short-wave receivers use condensers of very small maximum capacity in order to tune to the short wavelengths. When receivers of this type are used for the reception of waves above 200 meters, it is



This picture shows the location of practically all parts used in the construction of this short-wave receiver; the symbols correspond to those used in the wiring diagrams and the list of parts. L1 and L2, R.F. coils; T1, T2 and T3, audio transformers; V1, V2, V3, V4 and V5, tube sockets; C1, C2, tuning condensers; C3, regeneration condenser; R2, R3, R4 and R5, filament ballasts; R6, volume control; PH, oscillation control, Sw, switch controlling R.F. amplifier stage.

* Radio News *Blueprint Article No.* 52.



COIL NO.	1.	2.	3.	4.	5.	6.
TURNS ON SECONDARY COIL	2	3	8	19	40	94
SIZE OF WIRE ON SECONDARY	18	18	18	18	24	24
INSULATION ON SECONDARY	E	E	E	E	SSC	SSC
LENGTH OF SECONDARY	1/8"	3/16"	5/8"	1 1/2"	1 3/8"	2 3/8"
TURNS ON TICKLER COIL	2	2	4	6	15	20
SIZE WIRE ON TICKLER	28	28	28	28	28	24
INSULATION ON TICKLER	SSC	SSC	SSC	SSC	SSC	SSC
LENGTH OF TICKLER	1/32"	1/32"	1/16"	3/32"	1/4"	1/2"
LENGTH OF COIL FORM	1 1/4"	1 1/2"	1 1/2"	2 1/4"	2 1/4"	3"

Diagram gives complete details for building the six sets of coils required in order to give this set a wavelength range from 10 to 725 meters. The primary coil consists of 10 turns of No. 24 S.S.C. wire wound on a form 2½ inches in diameter, with whichever set of coils it is used.

necessary to use coils having a large number of turns of wire, in order to get an inductance value high enough to cover the waveband between 200 and 500 meters. While it is true that a tuned circuit having a large inductance and a small capacity will usually give louder signals from any given station than a smaller inductance and large capacity tuned to the same station, it is also true that the *selectivity* of the circuit using the small condenser and large inductance will not be as great as that of the other combination.

FAULTS OF EARLY DESIGN

It seems to have been the idea of the designers, of most short-wave receivers, that these were to be used entirely for reception of short waves; and that a separate receiver would be used for the regular broadcast band. While the use of plug-in coils will enable the operator of a short-wave receiver to cover the different bands, it will result in a receiver that is not very selective above 200 meters. The design of most of these short-wave receivers is rather a step backward, when compared with the usual set used for broadcast reception; since practically all of the sets designed for short-wave work are of the plain regenerative type.

It must be admitted that the use of two receivers has some advantages; but it must also be pointed out that the cost of two receivers is beyond the means of many. Besides this, there is the requirement of additional space, not only for the receivers but for the separate sets of batteries that would probably be used.

The special short-wave receiver described in this article was designed to be a flexible receiver, suitable for use on any wavelength band merely by plugging in the proper coils. By referring to the schematic diagram of this set, you will see that a stage of tuned radio frequency has been placed before the usual regenerative circuit. Because of this additional tuned circuit, the receiver is very selective on wavelengths above 200 meters, even though small tuning condensers are utilized. The audio-frequency amplifier has been designed for quality reception; it includes one stage of straight transformer-coupled and one of push-pull amplification. Thus, it will be seen that this set combines the advantages of both the broadcast and short-wave receivers in one flexible all-wave circuit.

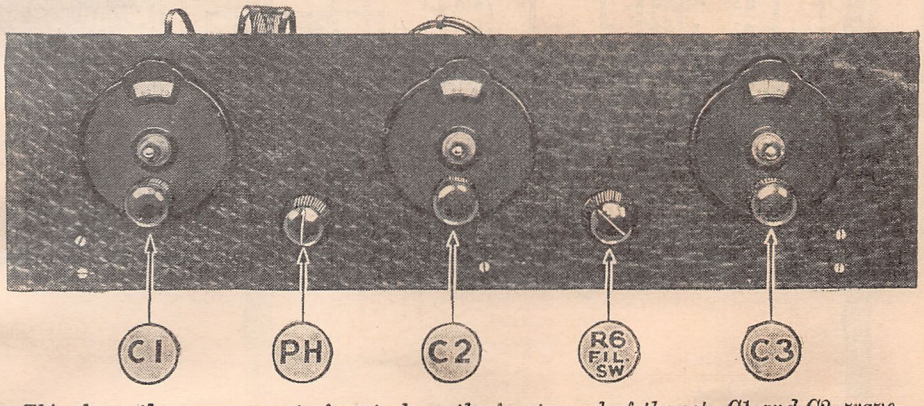
CONSTRUCTION

The set is so designed that the experimenter will find it easy to construct according to his personal desires, since a wide number of types of tubes can be used in the set. If it is not so desired, the audio-frequency end of the circuit need not be of the push-pull type; although the quality of reception will probably be somewhat better if this type of amplifier is used. Another point in favor of this receiver is that, although a complete equipment of coils to cover all the wavebands over which the set is capable of operating would be rather expensive, the constructor may purchase the coil mountings and two coils for the short-wave band at which the receiver is to be operated most frequently, and add the other coils later when finances permit. This feature alone is a good indication of the flexibility of this receiver.

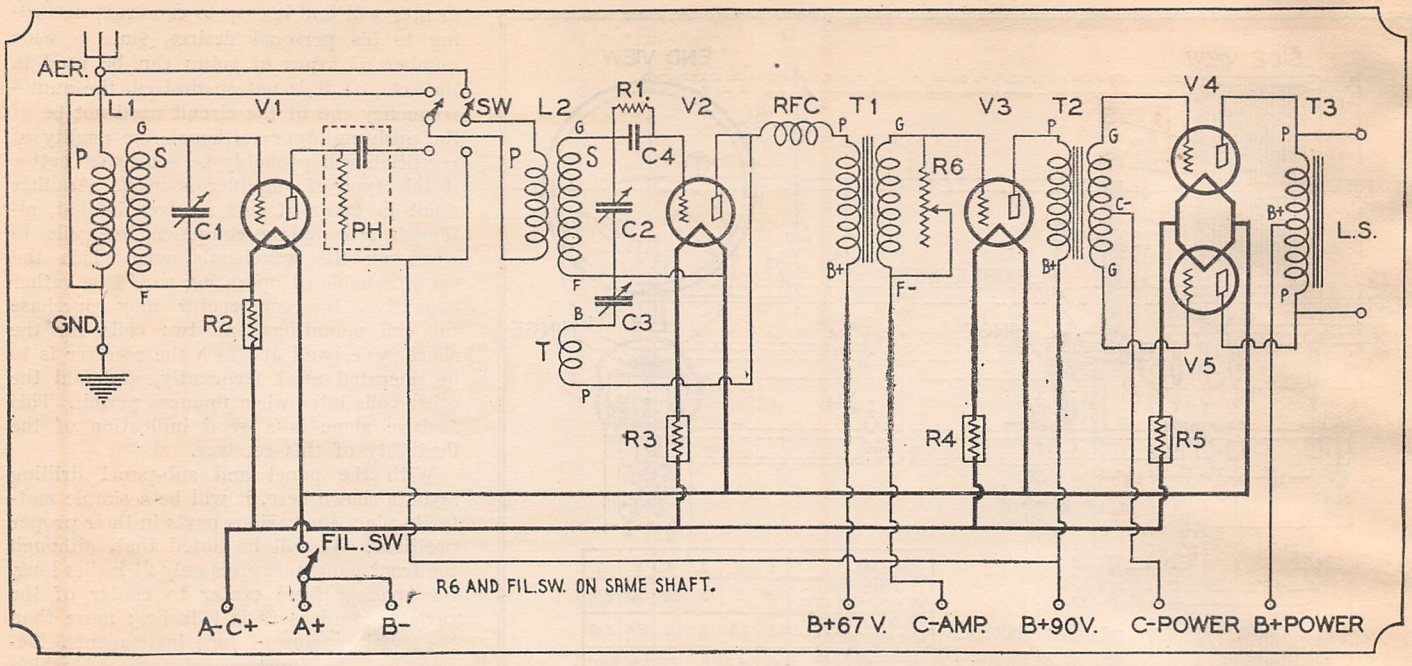
With the panel and sub-panel drilling layouts shown here, it will be a simple matter to place the various parts in their proper positions. It will be noted that, although the front panel measures only 24 inches long, the spacing from center to center of the variable condensers is 8 inches; more than the usual spacing of such instruments. Because of the short wavelengths to which this set can be tuned, this spacing was deemed desirable to prevent interaction between units and eliminate any need for shielding. The coils are placed at right angles to each other and sufficient space is left between them to assure correct operation.

In assembling the set, the sub-panel should be drilled first and the apparatus mounted on it. After this, the front panel should be drilled and the condensers (C1, C2 and C3) volume control (R6) and oscillation control (PH) mounted. Care should be taken in laying out the panel and sub-panel, in order to get the holes at the right points; as otherwise considerable difficulty will be encountered when mounting the apparatus. After all of the parts have been mounted on the panel and sub-panel, the brackets should be screwed into place and the set is ready for wiring. The oscillation control has been mounted on the front panel because of the need of readjusting it with the different coils and tubes that will possibly be used.

It will be noticed that a double-pole, double-throw, jack switch (Sw) has been incorporated in the set between the radio-frequency and detector tubes. This switch is for the purpose of comparing results obtained with the set when the radio-frequency stage is used and when the set is operated as a simple regenerative receiver. It is also helpful in adjusting the receiver when it is first tried out.



This shows the arrangement of controls on the front panel of the set. C1 and C2, wavelength tuning dials; C3, regeneration control; PH, oscillation control; R6-Fil. SW, volume control and filament switch. The plug-in coils are partly visible.



This schematic wiring diagram gives complete details of all electrical connections in the receiver; and the symbols which are used to identify them correspond with those in the other illustrations, as well as the text.

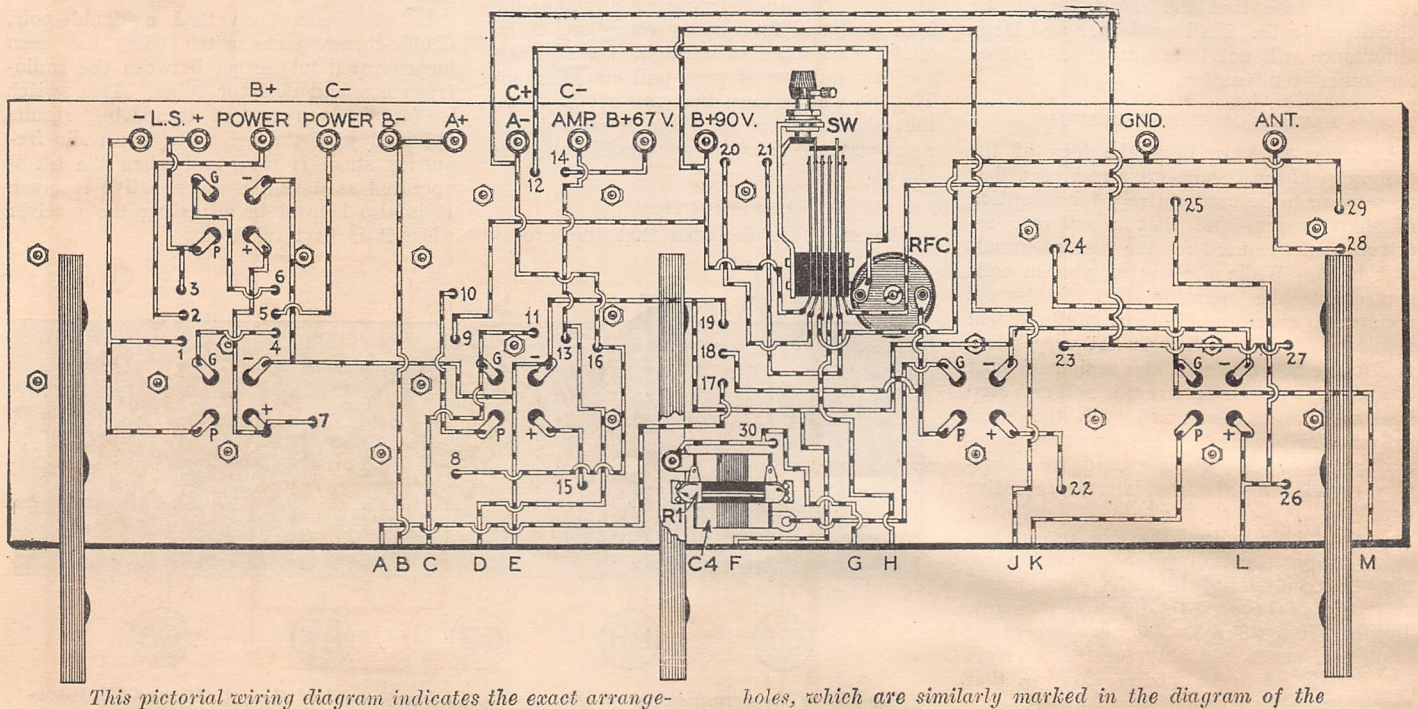
Care should be taken in placing the grid leak R1 and grid condenser C4, to keep them away from the plate wires leading to the radio-frequency tube (V1) and also from the radio-frequency choke (RFC) in the detector plate circuit. The sub-panel mounting brackets are placed as indicated; one slightly off center to provide additional support for the weight of the audio-frequency transformers (T1 and T2).

TESTING AND OPERATING

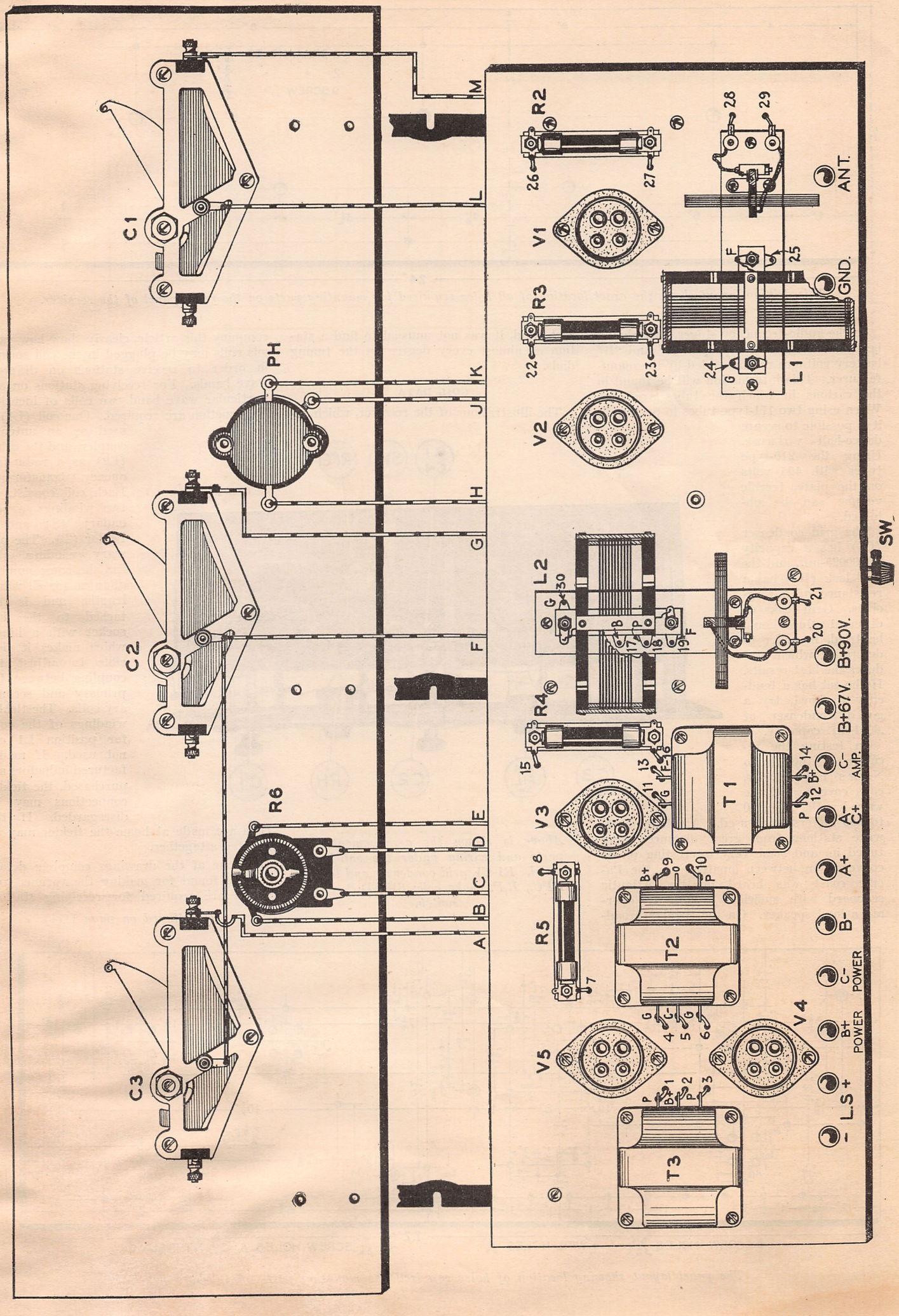
After the wiring is completed the set may be tested. It is best to throw the double-pole switch so that the aerial and ground are connected to the primary of the second tuning unit, in order to get accustomed to tuning the regenerative part of the receiver. It will be noticed that the set is very selective on the short waves; but, the nearer you come to the band between 200 and 500 meters, the more interference will be experienced. However, when the radio-frequency stage is connected in the circuit, the selectivity is very good, on both broadcast and short waves.

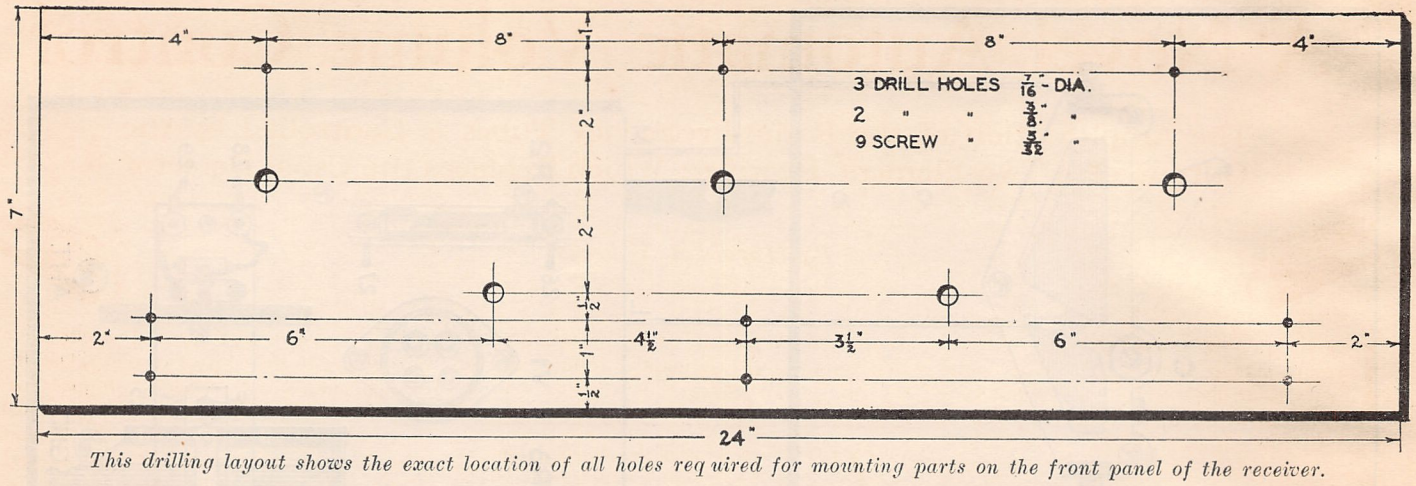
Having spent some time testing the receiver in this manner, the aerial and ground should be connected to the primary of the first tuning unit by throwing the switch (Sw) in the opposite direction. The adjustment of the oscillation control (PH) is not difficult. Tune in a station near the lower end of the condenser scale, turn back the dial of C3 and then slowly turn the dial on the oscillation control (PH) to the left. On retuning the dials C1 and C2 no squeals should be heard; if they are heard, turn the oscillation control still farther to the left. If it is found impossible to control the oscillation in this manner, move the primary of the second tuner further away from the secondary. The relation of the primaries on the tuning coils L1 and L2, to their respective secondaries, governs the selectivity of the set.

It was found in testing the receiver that different adjustments of the oscillation control (PH) were needed for some of the coils, although most of the coils could be operated without the adjustment. When experimenting with the set, a 199 tube was tried in the radio-frequency stage and was found to be easier to control than a 201A but, since it was not difficult to adjust the 201A and since the signals were louder with this tube, it was finally chosen. In changing the tubes, the automatic filament controls (R2, R3, R4 and R5) were found very convenient, since they are easily changed, permitting the use of any type of tube without changing the batteries.



This pictorial wiring diagram indicates the exact arrangement of all wiring under the sub-base panel. Letters and numbers in this drawing refer to corresponding wires and holes, which are similarly marked in the diagram of the wiring above the sub-base panel and the leads to panel apparatus, which appears on the opposite page.


C1
C2
C3
PH
R6
R2
R3
R4
R5
V1
V2
V3
V4
V5
L1
L2
T1
T2
T3
ANT.
GND.
SW.
B+90V.
B+67V.
C- AMP.
A- C+
A+
B-
C- POWER
B+ POWER
- L.S +



This drilling layout shows the exact location of all holes required for mounting parts on the front panel of the receiver.

In the audio-frequency stages, care should be taken to secure the proper "C" and "B" battery voltages recommended by the manufacturer. This information will be found in the cartons in which the tubes are sold. When using two 171-type tubes in push-pull, it is possible to secure dance-hall volume. Using the 210-type tubes with 425 volts on the plate, terrific volume can be obtained.

The grid condenser (C4) has a capacity of .00025-mf., and the grid leak (R1) has a resistance of 5 megohms. Grid leaks of different values should be tried, in order to determine which produces the best results. If the set has a tendency to howl, try a grid condenser of .0001-mf. capacity.

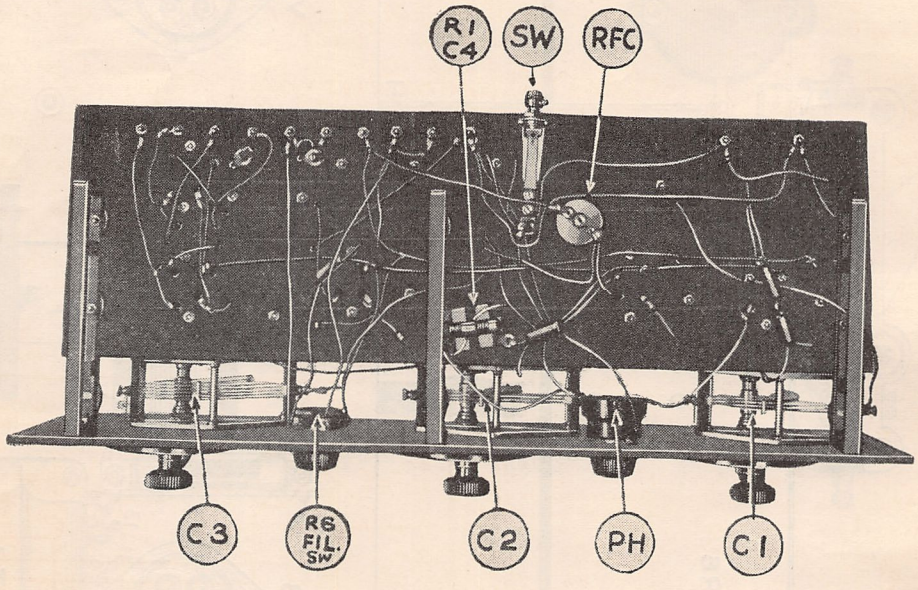
In testing the receiver in the Radio News Laboratories, coils covering all the wave-lengths from 10 to 550 meters were used. Amateur short-wave stations from great distances were tuned in, and some very interesting phone conversation between amateurs on the Pacific coast was heard on the Atlantic seaboard with sufficient volume to operate a loud speaker. On the regular broadcast band, it was not unusual to find a station at almost every degree on the tuning dials.

COIL DATA

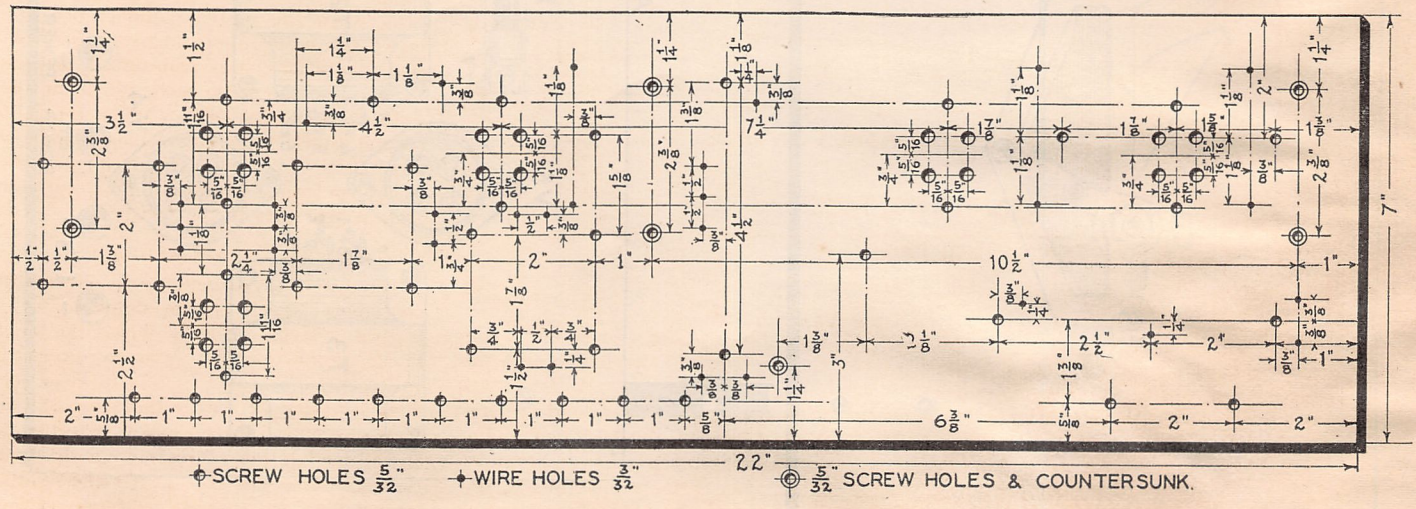
The illustrations of the receiver, which accompany this article, clearly show how various coils may be plugged in the coil sockets in order to receive stations on different wave bands. For receiving stations on any particular wave band two coils of identical construction are required. One coil (L1) is used as an antenna coupler, and the other (L2) as a radio-frequency transformer, Each coil consists of two windings, a secondary (S) and a tickler (T). The primary winding (P) has the same number of turns for all wavelengths and is attached to the coil socket with a hinge, which makes it possible to adjust the coupling between the primary and secondary coils. The tickler windings of the coils for position L1 are not used. If manufactured inductors are purchased, the tickler connections may be disregarded. If the coils are made at home the tickler may be omitted altogether.

In one of the drawings complete details will be found for making the various coils which are required for receiving stations

(*Continued on page* 1174)



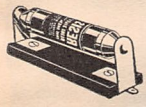
Above is shown the arrangement of parts and wiring under the sub-base panel. R1-C4, grid condenser and leak; RFC., R.F. choke coil; SW, D.P. D.T. switch.



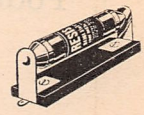
The panel layout showing location of holes required for mounting parts on sub-base panel.

A Novel Automatic Volume Control

The Amplification of the Radio-Frequency Tubes is Controlled by the Output of a Two-Element Rectifier, Which Replaces the Usual Detector



By Harold A. Wheeler



IN the present radio receiving sets employing high amplification, it is necessary to adjust carefully a "volume control" in order to reproduce signals of different intensities with the same audible intensity from the loud speaker. There are various devices which could be employed to regulate automatically the amplification of the signal, some of which employ moving mechanical parts. It is the purpose of this paper to describe a simple electric circuit, without moving parts, in which the amplification is regulated automatically by the signal, and the loud-speaker intensity reaches approximately the desired level for each signal, independent of the signal intensity and therefore irrespective of a reasonable amount of fading.

Any device to accomplish this object without introducing distortion of music or speech must be operated by the signal-carrier wave. Any variations in this wave's intensity must be compensated by reciprocal variations in its amplification. The method to be described provides for controlling the radio-frequency amplifier, thereby maintaining the desired signal level in the detector or rectifier, audio-frequency amplifier and loud speaker.

ESSENTIALS OF THE CIRCUIT

A set which has been constructed for broadcast reception, embodying this automatic volume control, comprises the following component sections: (1) A four-stage radio-frequency amplifier of the well-known neutrodyne type, with UX-201A tubes, the antenna circuit tuned by one dial and the four coupling transformers tuned simultaneously by a second dial. The total amplification is controlled by varying the negative grid potential of the first three tubes. (2) A two-element rectifier with simple filter circuits to reject the radio-frequency currents and to segregate the direct and audio-frequency components of the pulsating rectified voltage. (3) A manual volume control in the form of a voltage-attenuator connected to the grid of the first audio-frequency amplifier tube. (4) A four-stage audio-frequency amplifier and loud speaker. The entire set, except the last two audio-frequency stages, is enclosed in a grounded metal box divided into compartments, one for each tube with its preceding coupling circuit.

THIS article explains the principle of a most ingenious device by which it is possible to make a radio set adjust itself to the fluctuations in the strength of the received signal, thus partially overcoming fading, etc. This is brought about through the use of a rectifier circuit, rather than the common amplifying detector; and employing the variations in the rectifier output to vary the voltage on the grids of the R.F. tubes, and thereby their amplification. While the system, owing to the many problems yet to be solved in its operation under present-day broadcast conditions, is yet only in the experimental stage and further data are not available for publication, it is very interesting and will afford the more inquiring constructor an opportunity to study a very novel circuit action. —EDITOR.

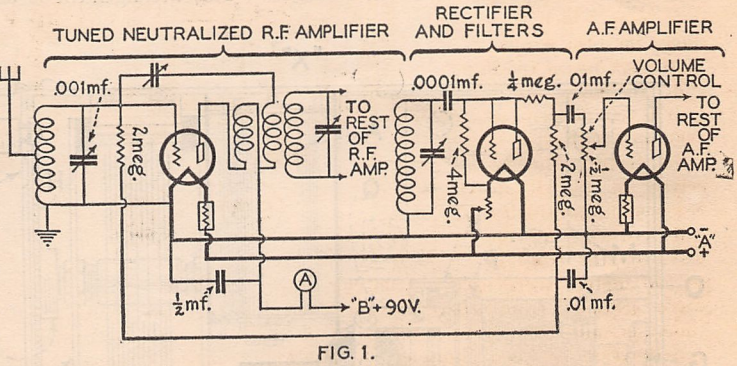


FIG. 1.

Fig. 1: This schematic diagram shows the fundamental circuit arrangement of the automatic volume control. Only the first R.F. stage appears here, but in the others 2-megohm resistors would be connected between their grid circuits also and the rectifier output. This circuit is still in the experimental stage, and has not reached a commercial basis; other circuit constants, therefore, are not available at the present time.

Fig. 1 shows the essential circuit details pertaining to the control system. The direct component of the rectified voltage, free of audio-frequency variations, is applied to the grids of the first three tubes. If the radio-frequency-rectifier voltage could exceed a value of about ten volts, this automatic grid bias would thereby cut off the signal through the radio-frequency amplifier; so the rectifier voltage cannot exceed this value.

RESULTS OBTAINED

Fig. 2 shows graphically the performance of the radio-frequency amplifier with and without the automatic control. With the system described, the rectifier voltage and audio-frequency voltages are nearly independent of the antenna voltage, when the latter exceeds the threshold value. The curves 1, 2 and 3 show the performance of the system when the automatic grid bias is applied to one, two, or three tubes, respectively, of the radio-frequency amplifier.

The degree to which the signal can be cut off in one tube is limited by two factors. First, any error in neutralizing the grid-plate capacity permits signal current to pass through the tube, even when its mutual conductance is zero. Secondly, the sharp bend in the plate-current-grid-voltage curve causes distortion of a strong signal on the grid, when the mutual conductance is reduced too far by the grid bias. In view of such limitations, it is undesirable to reduce the amplification ratio per stage below about 1/10 of its normal value. When controlling several tubes, these limitations become unimportant. The last radio-frequency stage is not controlled because it must supply as high as ten volts to the rectifier.

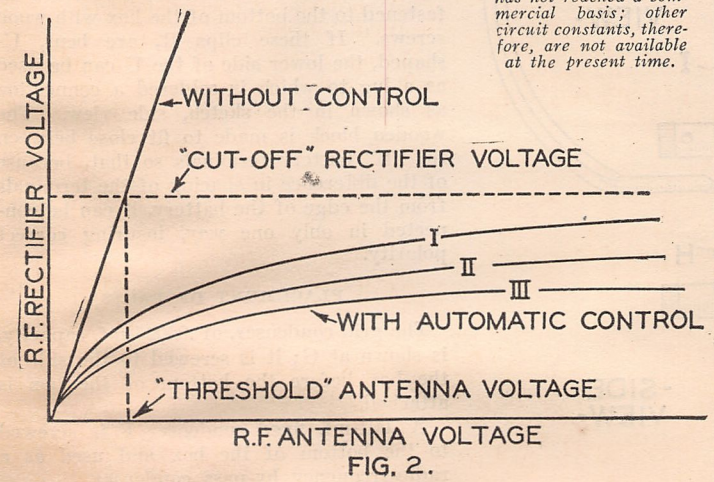


FIG. 2.

Fig. 2: These curves show the performance of the R.F. amplifier with and without the automatic volume control. It will be seen that with three tubes (curve III) the regulation is much more uniform than with two tubes (curve II) or with one tube (curve I).

DISTORTION AVOIDED

The properties of the two-element rectifier contribute largely to the simplicity of the control system. Fig. 3 shows the nearly linear proportionality between alternating and rectified voltages in this form of rectifier, as contrasted with the irregular performance of the three-element detector. The signal modulation is rectified without distortion. Also the average rectified voltage is equal to the carrier voltage rectified;

(*Continued on page* 1156)

A Really Portable Radio Set

An Efficient Little One-Tube Receiver, Which Weighs Less Than Four Pounds and Can Be Slipped Into an Automobile Side Pocket, Is Easily Made of Old Parts

By J. B. Armstrong

It is evident from this illustration that the portable radio set described in the accompanying article is really portable. The whole instrument weighs less than four pounds and can be easily carried with one hand.

MOST of the so-called "portable" radio receivers which the writer has seen are portable in about the same sense that a steamer trunk is; that is, you can put a handle on the latter and drag it around with you. It is easy enough to compress the parts of a four- or five-tube set, or even those of a superheterodyne, into a box about the size of a lady's overnight bag; but, after you've installed half a dozen dry cells and at least two "B" battery blocks and attempted to carry the outfit a few blocks, you will lose your enthusiasm for portable radio and drop into the nearest drug store for a bottle of muscle liniment.

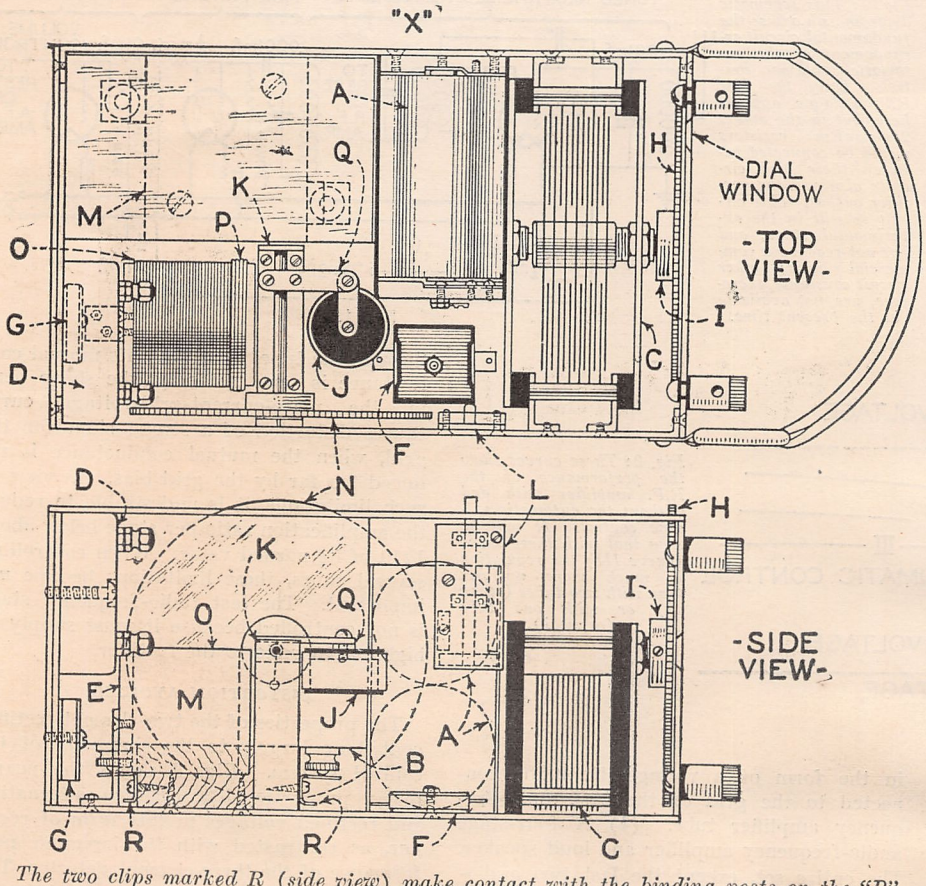
The writer has designed a portable radio receiver which is really portable in that it can be carried in one hand and will not cause drooping of the shoulders. It weighs less than four pounds, *complete with batteries;* so a description of it will undoubtedly be of interest at this time of the year, with Spring not so far away, and the call of the open faintly audible in the distance.

The metal case for this receiver measures 7 x 4¼ x 3 5/16 inches and is made of aluminum 1/16-inch thick. The long sides are flanged over and screwed to the ends, and the bottom is attached with angles.

DISPOSAL OF BATTERIES

Referring to the sketches of the set, A and B are the "A" and "B" batteries, which are used to operate a UX-199 tube fitted into the UX socket shown at D. The "A" battery consists of two of the larger unit cells used for flashlights; these are connected in series and held in a special compartment composed of two bakelite end pieces separated by two sides of aluminum. This compartment is fastened to the case by machine screws going into one bakelite endpiece, as shown in the sketch at point X, top view. The lower cell goes into the compartment with the "+" terminal towards the side of the box to which the compartment is fastened. The upper cell goes in with the "+" terminal facing the other way. This arrangement is used in order to allow the cells to be connected in series with a strip of bronze screwed to the bakelite end piece on the side of the box. These bakelite end pieces should have a groove running from top to bottom, to leave room for the brass ferrule of the terminal to slide into the compartment. The series bronze strip is screwed into the groove in the bakelite on the box side; this is done in order to allow the "+" and "—" terminals of the battery compartment to come out conveniently for wiring. The bronze connector is bent outwards from the bakelite to make contact with the lower cell's "+" terminal and the upper cell's "—" case. Two separate clips are screwed to the other bakelite strip of the compartment to form the "+" and "—" terminals of the battery compartment.

The "B" battery consists of a single 22½-volt block of the smallest size. It goes into the box upside down and connects with bronze clips screwed to a block of wood M, fastened to the bottom of the box with wood screws. If these clips R, are bent, U-shaped, the lower side of the U can be used as a lug to which is soldered a connection as shown in the sketch, side view. The wooden block is made to fit close between the "B" battery terminals so that, because of the difference in spacing of the terminals from the edge of the battery, it can be connected in only one way, insuring correct polarity.



The two clips marked R (side view) make contact with the binding posts on the "B" battery block. The 199 tube fits in the socket D, occupying the corner formed by the tuning coil O and the "B" battery B. The other symbols in these drawings correspond with those in the illustration and diagram on the opposite page.

PLACEMENT OF PARTS

The grid condenser, of .00025-mf. capacity, is shown at G; it is screwed to the side of the box before the bottom of the box is attached.

A .001-mf. fixed condenser F is screwed to the bottom of the box and used as a radio-frequency by-pass condenser.

The variable condenser, C, is of .00035-mf. capacity; any condenser of this size may be used providing its spread will not exceed the depth of the box when it is rotated. The condenser is secured by small brass angles, four in number, which are fastened to it by using longer assembly screws. The frame and rotary plates are thus connected to the box and so to ground and "A+" and "B—". The condenser is controlled by the

knurled disc H of 1/16-inch aluminum, which projects through a slot in the lid of the box. To allow it to project only through the lid, the center line of the shaft of the condenser must be above the half-way line of the box by an amount equal to the distance the disc projects. No clearance need be allowed, between the frame of the condenser and the "A" battery compartment, if the condenser is fitted with countersunk assembly screws and the bearing parts are sawed off flush with the frame as shown. A paper dial can be borrowed from some old vernier dial and cemented to the aluminum disc with household cement or collodion. The figures on the dial are read through a window in the side of the box, under the handle.

A filament switch L, which is mounted on a brass plate, consists of a brass sliding member with a cross bar which slips beneath two small spring-bronze strips, one of which is grounded to the supporting plate. The other strip is screwed to a piece of bakelite and so insulated from the base. The sliding member slides through two brass bridges milled to fit and is bent over at right angles on the top to provide a grip. The switch is "on" when pulled out, and can be made flush when "off;" although this necessitates opening the box to turn the tube on. This filament switch is the only control used on the tube filament; as the two unit cells give the proper voltage without the use of a rheostat, and should be discarded when the tube will no longer function. This will be usually after approximately one hundred hours of service.

THE CIRCUIT

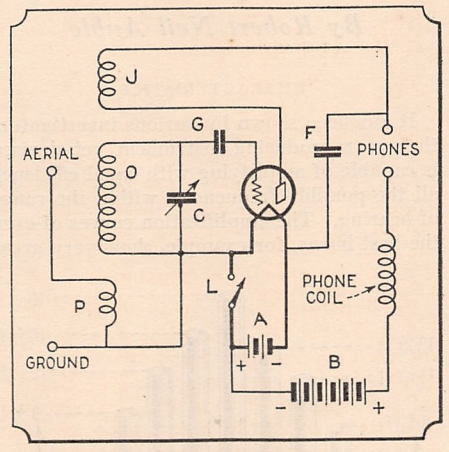
Now we come to the tuner; this consists of three coils, used in the conventional regenerative circuits as primary P, secondary O, and tickler J. The secondary, O, was wound first, using as a form, a cardboard tube such as comes around the large unit flashlight cells; it consists of a two-layer banked winding of No. 28 enameled cotton-covered wire, 1¼ inches long, and held in place by celluloid cement. No taps were brought out, as the tuner was found to cover the broadcast band nicely, with the .00035-mf. condenser.

(*Editor's Note*: Ordinarily it is against the policy of Radio News to publish hook-ups or descriptions of plain regenerative receivers, because of their obnoxious property of causing interference in neighboring sets. This portable receiver is excepted from the ban, as it is unlikely to be used in crowded districts.)

The primary, which is wound directly over the secondary on the filament end, which is nearest the tickler coil, consists of three turns of No. 22 D.C.C. and is untuned.

The tickler coil consists of a winding 7/16-inch long, of No. 28 S.C.C. wire in two layers (not banked, simply one over and then back on the first layer) on a bakelite tube ⅞-inch in diameter. Two pig-tails covered with soft sleeving are brought out from the coil of stranded wire. To rotate the tickler, the disc N, of 1/16-inch aluminum, is used with a tight-jointed brass angle support Q, which is clamped at K to the disc shaft and screwed to a bakelite end piece cemented into the coil form. The control disc has bearings in a U-shaped brass strip fastened to the bottom of the box. The shaft has a shoulder turned on each end, to keep it from sliding out of the bearings; and the bearing strip itself is split and sprung to take up all play.

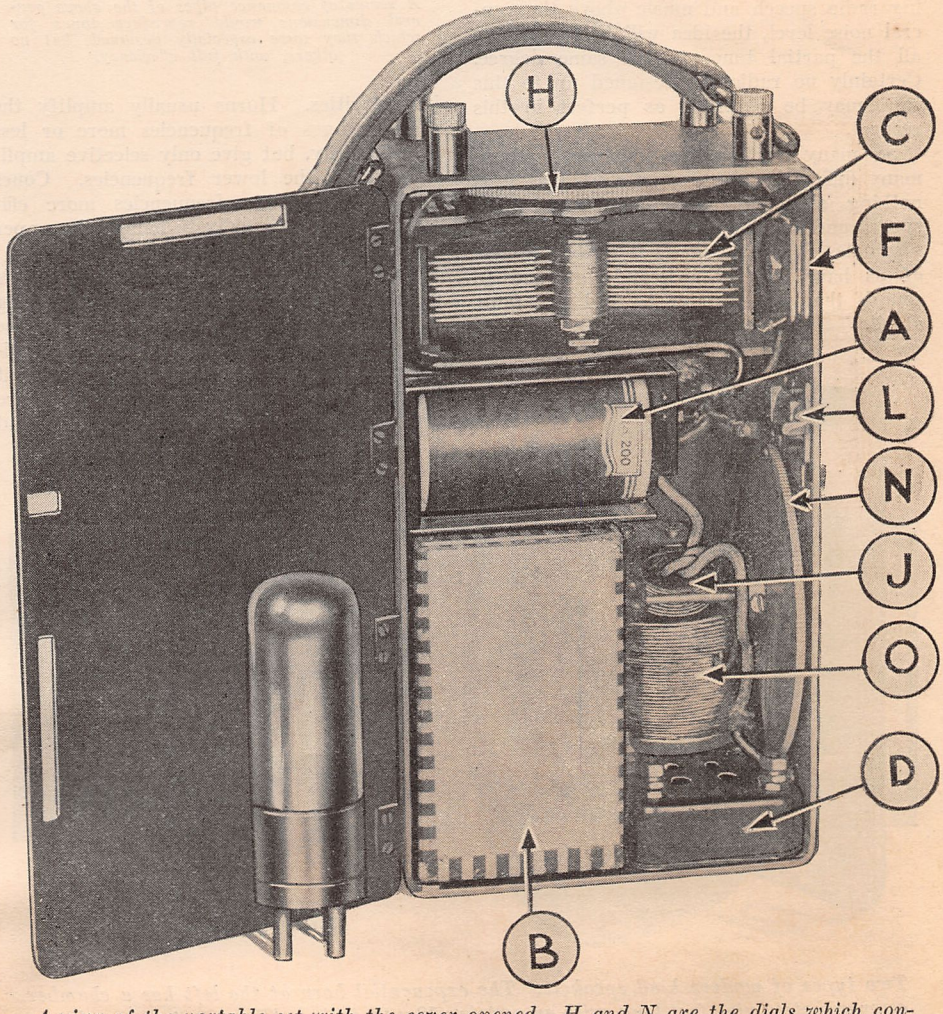
Four binding posts are mounted on the condenser end of the box and insulated with fiber bushings and washers, with the exception of the ground post, which is mounted right on the aluminum case without insulation. Two of these posts are connected to aerial and ground respectively, the other two being phone connections in the plate circuit of the tube. This brings one post at 22½ volts above ground with the tube filament also grounded; so that the tube would be burned out in case the post should be accidentally connected to the box, as when inserting the phone tips, etc. To get around this difficulty, there should be mounted within the set (under the variable condenser) an old headphone coil, of approximately 500 ohms resistance, which should be connected in series with the "B+" battery circuit. This will limit the short-circuited current to a harmless value, yet not impair the operation of the set.



The complete wiring diagram of the portable receiver. The extra phone coil prevents damage to the tube filament, in case of an accidental short-circuit.

ACCESSORIES

A handle, such as that supplied for a hand bag or small suit-case, was procured from a leather-goods store and fastened to the box with small metal clips, as shown; the set complete with batteries weighs 3 pounds 9½ ounces. It is completely shielded and may be handled while tuning in stations without the slightest body-capacity effect. It has brought in broadcasting over distances of 1500 miles on a good antenna during the summer months. A single-turn loop 24 inches in diameter works excellently with this little receiver; it is connected across the primary coil as with a regular antenna. Station WGY has been heard very clearly with this type of antenna and receiver over a distance of twenty-five miles; at a distance of six miles, it comes in loudly enough on an outdoor aerial to be heard across the room on a loud speaker without amplifiers. Carrying the set with one hand and using a loop consisting of three feet of wire laid across the shoulders and hanging vertically, one may hear broadcasting from WGY while walking about—if insane enough about radio to try it. (Yes, the writer has tried it.)



A view of the portable set with the cover opened. H and N are the dials which control the tuning condenser C and tickler coil J, respectively. F, by-pass condenser; A, filament batteries; L, filament switch; O, secondary coil; D, tube socket.

What Constitutes Tone Quality?

Part II of an Article in Which is Considered Sound Reproduction and its Relation to the Reception of Radio Broadcast Signals

By Robert Neil Auble

IT was pointed out in the first part of this article, which appeared in March RADIO NEWS, that a radio set may be regarded as perfect only when the sound reproduced at the loud speaker is faithfully like that originally produced before the microphone. This involves the problem of insuring that every fundamental tone and every overtone sounded before the microphone may be reproduced at the loud speaker, with emphasis unchanged and without the intrusion of any other sound whatever.

While it is no doubt true that the relative emphasis of the various partial tones must be preserved in the ideal transmitting system, it is also possible, however, that a transmitting system may fall somewhat short of this ideal without objectionable results. Certain types of extraneous sounds must apparently be always present in any sound-reproducing system—as needle noises in the phonograph, line noises on the telephone, static and other background noises on the radio. Still, it is obvious that, in amplifying radio speech and music above the general noise level, the idea will be to amplify all the partial tones to the same degree. Certainly no radio set designed up to this time may be regarded as perfect in this respect.

So many factors are involved, and so many difficulties are encountered, that it is nothing short of miraculous that radio speech and music are so deceptively like the originals. Very fortunate it is that so few of us have ears so delicately attuned to sounds that we are able to find any fault at all.

"CHARACTERISTICS"

It has been shown by various investigators that no reproducing instrument yet devised is capable of amplifying with equal efficiency all the possible frequencies within the range of hearing. The amplification curves of even the best horns, for example, show very great

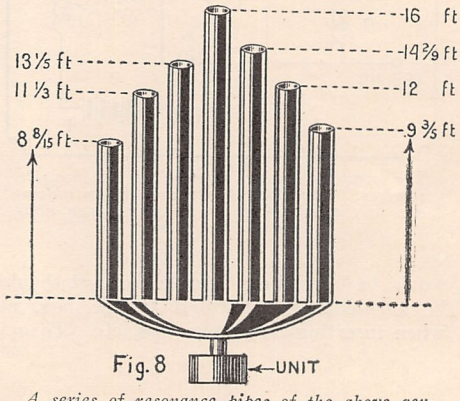


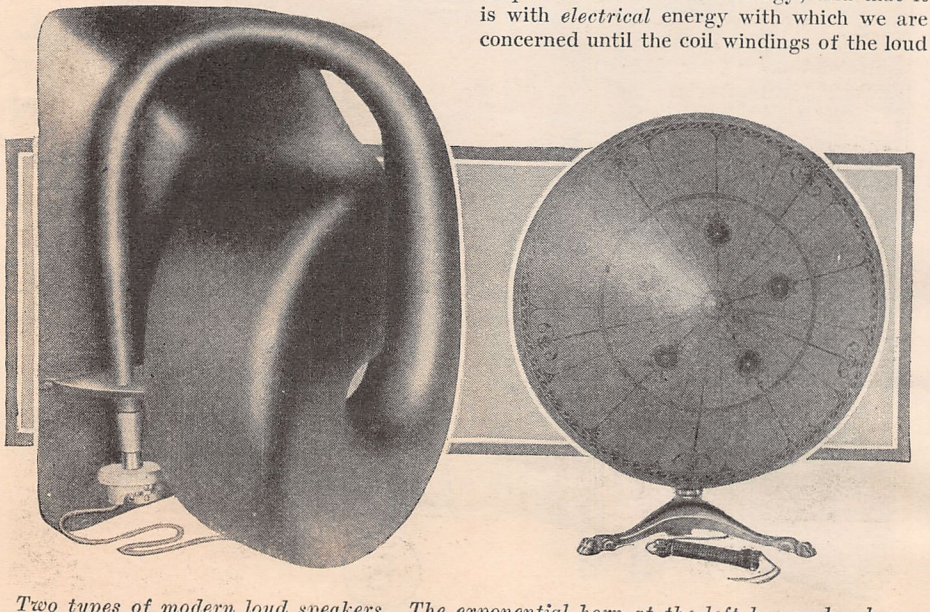
Fig. 8

A series of resonance pipes of the above general dimensions would reproduce tones for which they were especially designed, but no others, with full efficiency.

irregularities. Horns usually amplify the upper ranges of frequencies more or less satisfactorily, but give only selective amplification to the lower frequencies. Cones amplify the lower frequencies more efficiently, but fail usually to handle the upper tones so well.

To simplify the discussion of quality, it is desirable to remember that the transmitting unit is essentially a device to convert the energy of sounds produced before the microphone into electrical energy; and that it is with *electrical* energy with which we are concerned until the coil windings of the loud speaker are reached. Obviously, there is possibility of change of quality—"distortion"—at every point: any imperfection in the microphone, any fault in the amplifying and modulating systems at the broadcast station, any atmospheric disturbances between the transmitting aerial and the receiving aerial, any faults in the tuning circuit, the detector circuit, or in the audio-frequency amplifier of the receiver—all of these will modify the wave form of the electrical energy delivered to the loud speaker and introduce changes in the sound waves into which the electrical energy is converted by the loud-speaker unit.

We do not intend to go into any extended discussion of the electrical factors enumerated above, since the whole science of radio design is involved. It will be sufficient here to state that almost any well-designed radio set now on the market, if properly handled, will deliver to the loud speaker electrical energy whose wave form is practically identical with that which left the antenna of the broadcasting station.



Two types of modern loud speakers. The exponential horn at the left has a chamber approximately nine feet long, with an opening 18 x 24 *inches. The cone-type speaker at the right is* 24 *inches in diameter and has five points of suspension.*

DISTORTION IN THE SPEAKER

Loud-speaker design has not, however, kept pace with the design of other radio units. As was mentioned above, most of the horn-type speakers amplify the higher partials well enough, but do not handle the low notes efficiently. And without the support of the strong bass notes, the principal charm of music is lost. The writer has frequently heard through radio receivers orchestral arrangements which seemed pitched a full octave higher than the musical score indicates. The horn was failing to deliver any of the fundamental notes, leaving the listener to depend entirely upon the overtones. Such loud speakers are especially cruel to the voices of male speakers, whose voices are robbed of the sonorous tones of the lower register which give them their character and identity.

On the other hand, the cone and drum types of loud speakers so emphasize the lower tones that speech and music acquire a disagreeable rumbling character, resembling the sound of thumping on an empty barrel.

A horn is essentially a resonance chamber which amplifies the sound of the loud-speaker diaphragm, by virtue of the fact that the air column confined within the horn is forced into vibration in unison with the diaphragm. If the horn were cylindrical in shape, it would respond only to sounds whose wavelengths are twice the length of the tube, or to sounds whose wavelengths are such that the tube is exactly one-third, one-fourth, one-fifth of them, and so on. For example, if the tube is approximately 27 inches long it will respond to middle C (256 vibrations per second), to C′ (=512), to G′ (=768), etc. The intermediate tones are not amplified. Since a cylindrical reso-

nance tube responds only to selected sounds, to reproduce the whole range of audible sounds with cylindrical resonators would require a series of resonance pipes like a concert pipe organ. Such a "loud speaker" would, of course, be out of the question in the average residence. A sketch diagram of a possible loud speaker of this type is given in Fig. 8.

Such a loud-speaking unit as represented would efficiently amplify only the tones

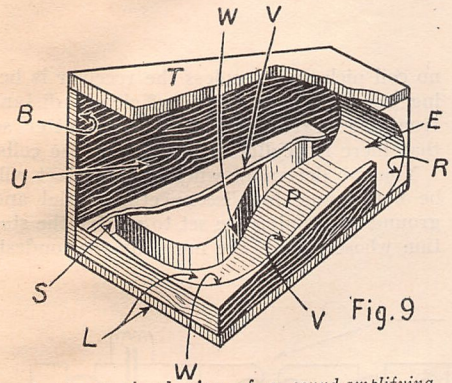


Fig. 9

A cross-sectional view of a sound-amplifying horn designed by Dr. A. L. Foley, of Indiana University.

which are harmonics (even multiples) of the major scale (without the "semitones") beginning with C = 32 vibrations per second. This would include most of the notes ordinarily used in music, but even so, would not be completely satisfactory, unless the instruments at the broadcast studio were tuned to physical pitch and unless the temperature in the studio were the same as in the room containing the speaker. Under such conditions the device would be highly efficient.

THE "EXPONENTIAL" HORN

Fortunately, however, the effect of a multiple series of resonance pipes may be secured by gradually increasing the diameter of the tube from its mouth outward toward the bell. If such a horn is used the sound waves are internally reflected so that the tube becomes less and less selective; *i.e.,* it becomes resonant for an increasingly large number of tones, the fundamental tone, however, remaining the same as that of an open cylindrical tube of the same length. A simple straight "conoidal" horn having a *logarithmic* rate of increase in its diameter from vertex to bell, will respond to practically all the audible frequencies; provided its length is of the order of twenty-five to thirty feet.

A horn of such length would be unwieldy, and despite its superiority over every other type of amplifying horn, must give way to less cumbersome, though less perfect horns in the average home.

If a horn, such as described above, be curved more or less abruptly the number of internal reflections is increased, making it possible to reduce the length without diminishing the number of frequencies to which it will respond. There is, however, a considerable loss of energy at such points of curvature, unless the amount of curvature at each point be exact. The superiority of certain horns now on the market is principally due to a better calculation of the curvatures.

But no matter how perfectly the curvatures are calculated, there is a lower limit to which the length of a horn, measured along its axis, may be reduced. So many horns, answering the demand for reduction of size to the dimensions of the cabinets in which they are to be placed, cannot respond to the lower notes adequately. Music heard through such horns lacks depth and character. The melody and harmony may be ever so brilliant but, without the background of the bass notes, the final product seems shallow and uninteresting. The basses are like the background of mountain and forest, over which the strings and woodwinds play with all the gorgeousness of a beautiful sunset.

ACTION OF THE CONE

The cone type of loud speaker depends upon another principle of sound amplification. The loudness of a sound, at a given distance from its source, may be increased by increasing the amplitude of the vibration (increasing the actuating forces), or by increasing the area of the vibrating object. The cone accomplishes its purpose by substituting its larger surface for the small diaphragm, which is the source of sounds in the horn type of speaker.

Such a large vibrating surface disturbs a much larger volume of air than is possible with the diaphragm, so that the amount of energy reaching the ear is increased without the use of amplifying horns. The material of the cone must vibrate in numerous irregular segments if it is to amplify all the elements of the complex tones. The cone is a modified Chladni plate, such as was described in Part I. As pointed out there, the higher the frequency of the note sounded, the smaller must be the vibrating segment. Since the factors of texture and elasticity establish a limit to which the segments may be reduced, such a vibrating cone cannot amplify sounds whose frequencies pass a fixed upper limit, if it is at the same time to amplify the bass notes, for which it is especially suitable. The absence of the upper partials in sound reproduced by a cone gives it the peculiar "empty-barrel" effect.

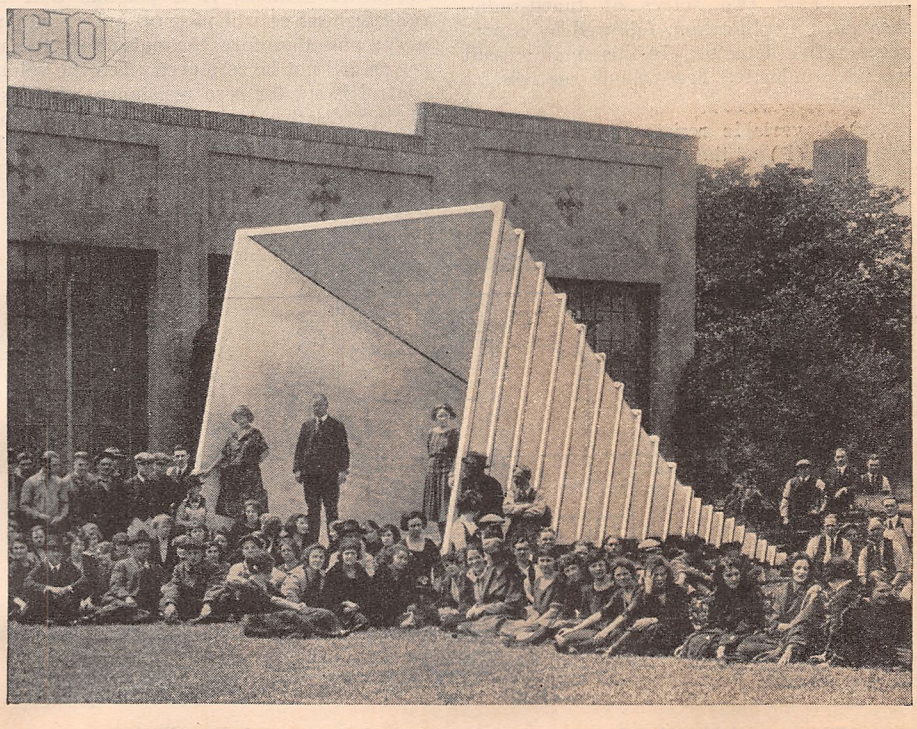
It is now evident that it would be desirable to combine the advantages of the cone with those of the horn. The writer described one possible scheme for accomplishing this result (RADIO NEWS, October, 1927), by means of an ordinary loud-speaker unit, so arranged that the diaphragm actuates the drive-rod of a cone on its lower surface, while the upper surface is open to the conventional horn.

A much better arrangement has been designed by Dr. A. L. Foley, of Indiana University (*Proceedings of The Indiana Academy of Science,* 1926, p. 131). Dr. Foley constructs a horn of massive elastic material, so curved and with such a rate of increase in its diameter that the best advantages of the horn are retained. Within the horn, and forming one wall of the air passage, is placed a sounding board of thin elastic material (see Fig. 9). The sounding board preserves the amplification ratio for the lower notes, while the horn amplifies the upper notes, as explained above. Dr. Foley describes the action of his horn, as follows:

"The cross-sectional area of the passage P being relatively small, the sound waves (compressions and rarefactions of the enclosed air) tend strongly to produce vibrations of the walls of the passage. The two side walls W and the lower wall L are massive and stiff. The upper wall, called the vibrator, V, is of thin elastic material and is of such a shape that it can readily vibrate in unison with the sound waves passing underneath. The vibration of V sets up waves which pass across the horn (transverse to the horn's axis), where they are again transversely reflected by the top T to the vibrator board. Several such reflections may take place before the waves finally emerge at B. This multiple reflection again greatly increases the effective length of the horn and increases the frequency range of resonance.

"Note that the wider end of the vibrator is at the rear end of U and that it naturally vibrates at a lower rate than the narrow

(*Continued on page* 1179)



A gigantic exponential horn made in 1922 *for the purpose of studying sound waves in this type of horn. It is capable of amplifying the lowest audible tones.*

Controlling Volume in Your Receiver

An Explanation of the Respective Merits of the Methods of Controlling Receiver Volume by Means of Variable Resistors

By John B. Brennan Jr.

THE method by which volume is to be controlled in a radio receiver deserves a considerable amount of attention. When listening to a local station it will be usually found necessary to utilize this control on the receiver to reduce the signal somewhat, so that the reproduced program will not be too loud. Therefore, the method used should be one which will regulate the volume without affecting the performance of the receiver in any way.

We may define the ideal volume control as one which will control the volume output of a receiver without affecting in any manner the receiver's selectivity or fidelity of reproduction. Few of the methods usually adopted measure up to this standard; but there are several which are quite satisfactory. In the following paragraphs we will indicate the characteristics of the various types; so that the reader will be able to determine, by examining his receiver, whether that employed is really the most satisfactory one.

To make our discussion systematic, we will begin by dividing volume controls into two broad classes, according to their positions in the circuit. The first group will include all the methods whereby the volume is controlled by some device in the radio-frequency circuit. The second group includes all controls that function in the audio-frequency circuits.

METHODS IN THE R.F.

In Fig. 1 is shown a conventional circuit consisting of two stages of tuned-radio-frequency amplification, followed by a non-regenerative detector. In this single circuit we have indicated five volume controls, as follows:

(A) A variable resistor across the primary coil (P) of the antenna coupler.

(B) A variable resistor in series with a tuned circuit.

(C) The filament rheostat.

(D) A variable resistor in series with the "B+" lead to the R.F. tubes.

(E) A variable resistor across a tuned circuit.

Method A, utilizing a variable resistor of about 200,000 ohms connected across the antenna coil, is generally quite satisfactory. However, if the receiver is unshielded and is being operated close to one or more broadcast stations, it is possible that the coils themselves will pick up quite some energy; and therefore the output of the receiver will not be zero even when the volume control is set for zero resistance. This is a distinct disadvantage, for the control is not effective on those stations (powerful nearby locals) where it is most essential. This type of volume control is not recommended unless the receiver is shielded so that there is no coil pick-up, or unless the receiver is being operated at a point sufficiently distant from the nearest broadcast transmitter so that there is negligible pick-up by the coils.

You can determine whether this effect will be bothersome by disconnecting aerial and ground and tuning the set to receive the station whose signals are normally the loudest. Under these conditions a good healthy signal indicates that there is coil pick-up, and volume-control method A should not be used.

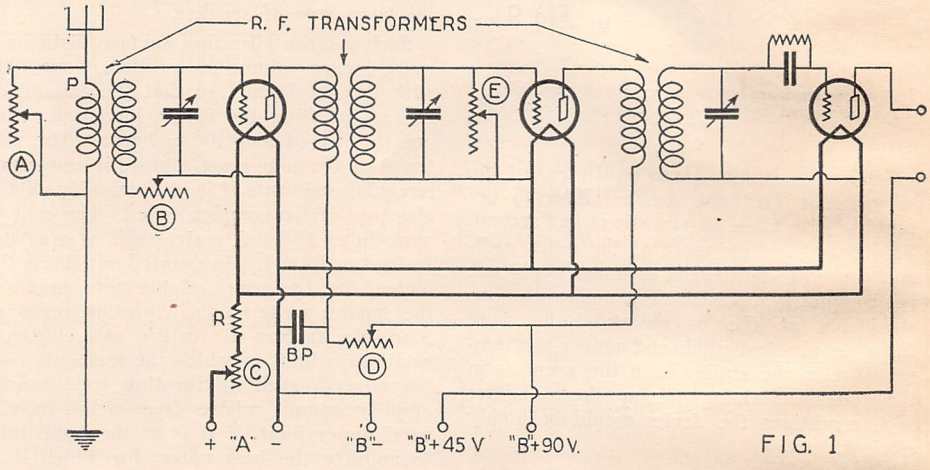


FIG. 1

Five different methods of controlling the volume are indicated by letters in this diagram of an R.F. amplifier and non-regenerative detector.

A resistor in series with one of the tuned circuits, as indicated at B in Fig. 1, is frequently an effective means of controlling volume where the selectivity problem is not severe. When resistance is introduced into a tuned circuit the selectivity of the circuit is seriously reduced, and it is possible that interference will be experienced between stations operating on adjacent channels.

REGULATING "A" AND "B" VOLTAGES

A rheostat controlling the R.F. tube filaments (C, Fig. 1) is frequently used as a volume control and really proves very satisfactory, except, of course, with A.C.-filament tubes. As the filament current is reduced, the emission from the filament is decreased and the resultant increase in the plate impedance of the tube causes the amplification to decrease; the signal finally reaching the detector is thereby reduced. It is a good idea, when such a control is used, to place a fixed filament resistor R (Fig. 1) in series with the volume-control rheostat. This resistor protects the tubes from an overload of filament voltage for then, even with the rheostat resistance all out, the filament voltage is limited to the correct value for the tube.

Since this control functions by limiting

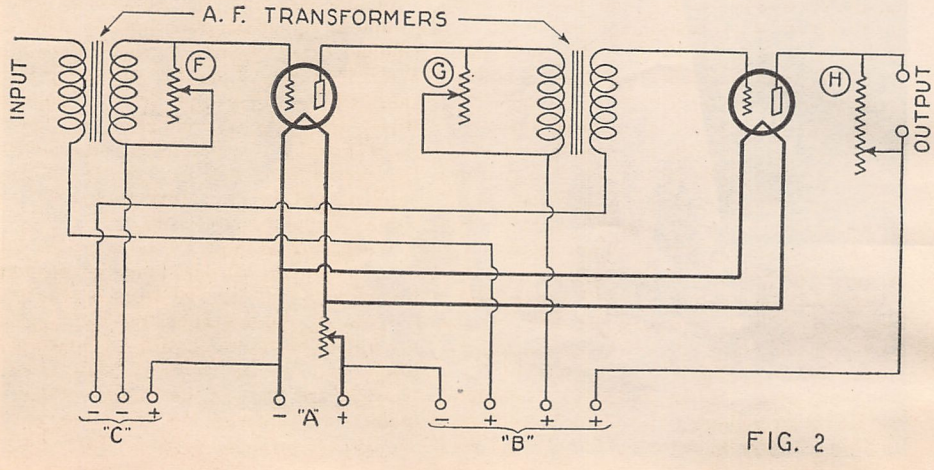


FIG. 2

Three methods of volume control in a transformer-coupled audio-frequency amplifier are shown at F, G and H.

TABLE OF RECOMMENDED RESISTANCE VALUES FOR VOLUME CONTROLS

See Fig.	Position of Resistor	Average Value in Ohms (Maximum)	Characteristics
(1 A)	Across antenna coil	200,000	Very good, except for an unshielded receiver in a congested broadcast area.
(1 B)	In tuned R. F. circuit	400	Decreases selectivity.
(1 C)	Filament rheostat	†	Very good.
(1 D)	In series with R. F. "B+" lead	200,000	Satisfactory with most types of receiver.
(1 E)	Across tuned R. F. circuit	200,000	Decreases selectivity.
(2 F)	Across A. F. T. primary	100,000	These methods are generally less satisfactory, as they permit the detector and A. F. amplifier to be overloaded by strong signals, with consequent distortion.
(2 G)	Across A. F. T. secondary	500,000	
(3 A)	*Potentiometer-grid leak	500,000	
(3 B)	*Variable grid leak	1,000,000	
(2 H)	Across loud speaker	25,000	

*In resistance-capacity-coupled A. F. amplifier.
†Depends on number and types of tubes.

the emission current, thereby increasing the plate impedance of the tube, it follows that it must produce *some* distortion. By experience, however, we know that the distortion created is not generally noticeable and the method can therefore be considered a good one.

At D in Fig. 1 we have indicated another volume control arrangement which functions by lowering the amplification in the R.F. amplifier through a reduction of the plate voltage. When this type of control is used, a by-pass condenser (BP) should always be connected from the "A —" to that side of the variable resistor or leading to the primary of the R.F. transformer. The condenser should have a value of .005-mf. or more.

Method E, utilizing a variable resistor across a tuned circuit, falls into the same class as method B. A resistance of given value *across* a tuned circuit is equivalent to a smaller resistance connected *in series* with the tuned circuit. Methods B and E therefore fall heir to the same objections and neither of them can be considered a really satisfactory method of volume control. This completes our story on volume controls functioning in the R.F. portion of a receiver. The various controls listed are grouped in the table; you will find listed there the major facts concerning each method.

IN A.F. CIRCUITS

We now come to the method of controlling the volume by means of some adjustment in the audio amplifier of a receiver. First, let us consider a two-stage, transformer-coupled amplifier (see Fig. 2). Here we have indicated three controls, F, G and H. Methods F and G are really similar; a very high resistance across the secondary of a transformer being equivalent to a lower resistance across the primary. The method used is optional, the major difference being that a variable resistor across the *primary* for volume control should have a maximum value of about 100,000 ohms, and a resistor across the *secondary* should have a value of about 500,000 ohms. Method H is not satisfactory, except in special cases; as, for example, when the receiver is located some distance from the loud speaker.

Volume control in a resistance- or impedance-coupled amplifier can easily be accomplished by using a high-resistance potentiometer (Fig. 3, A) or by simply using a variable high resistor for the grid leak (Fig. 3, B). The method indicated at A is somewhat preferable if a high-resistance potentiometer with a resistance value from

(*Continued on page* 1158)

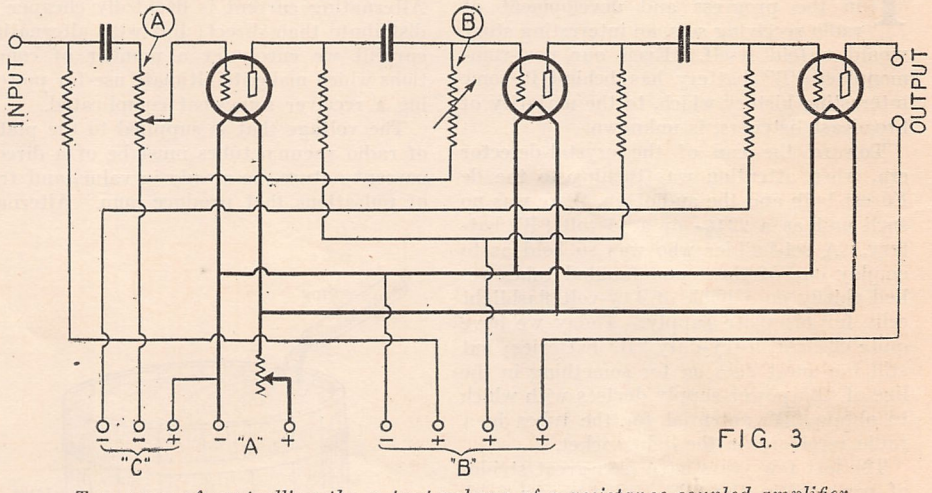


FIG. 3

Two ways of controlling the output volume of a resistance-coupled amplifier. A—potentiometer-type grid leak; B—straight variable grid leaks.

How Powerful a Tube Does Your Set Need?

IS exceedingly high plate voltage necessary for high quality in radio reproduction? Many set owners, noticing the numerous constructional articles dealing with "B" power devices having an output of 500 or more volts, and designed for use with power tubes of the 210 type, are perhaps inclined to believe that real quality can only be obtained through the use of these voltages and tubes.

This, however, is not always the case. A moderately powered amplifier, using tubes of the 112 or 171 type with plates supplied from a 150- or 180-volt source, can, in most circumstances, give results that will satisfy the most critical. The main advantage to be expected through the use of higher power is a gain in volume and the increased realism that comes in having, let us say, the volume of an orchestra, as it comes from the speaker, equal or exceeds that of the orchestra itself. However, it is obvious that the average set owner is not desirous of having a twenty- or sixty-piece orchestra going full tilt in his or her living room. In a small room—and many rooms are small nowadays—this would be unpleasant, even painful. Therefore, an amplifier capable of giving this volume could seldom be used.

USE OF SMALLER TUBES

Now in a case like this, where quality, rather than quality plus tremendous volume, is the primary consideration, there is nothing to be gained by the use of very high power. To be enjoyable, the device of very high voltage would of necessity have to be operated at a point considerably under maximum output. If a proper means of controlling this volume were used, the quality would not suffer; but it would not be better than the maximum output of an amplifier more in accordance with the tastes of the average set owner and the acoustical capacity of his home.

Of course, there is no denying the fact that power and fidelity in reproduction are, up to certain points, closely associated. The set owner should remember, however, that a moderately-powered amplifier puts every bit as much energy into the loud speaker as a very-high-voltage device operated at a fraction of its volume. In the latter case, the energy, as expressed in the A.C. variations of the plate current, remains in reserve, or is dissipated by means of the volume control. When control is attempted by means of reducing the filament voltage, or through slightly detuning the set, the results, particularly in the case of the high-voltage amplifier, are far from satisfactory. In the case of sharply-tuned receivers, serious distortion results from the suppression of the side bands when the set is detuned; while extraneous noises, static, line disturbances, etc., are amplified out of all proportion to the signal.

VOLUME OF QUALITY

In the last analysis, quality in the reproduced signal is not so much a matter of volume as of *freedom from overloading.* Were it purely a matter of amplification, tubes of the 201A type, or the "high mu" tubes, would be far superior to those of the 171 and 210 types. The superiority of the power tube lies, not in its ability to amplify, but in its ability to handle great volume without overloading.

When, for example, a tube of the 201A type is used in the last stage of an amplifier with, let us say, 90 volts on the plate, the sounds issuing from the loud speaker are apt to be thin and with the tones in the lower end of the musical scale missing. Now, as we increase the plate voltage, the quality of reproduction improves until a

(*Continued on page* 1161)

The Action of "B" Socket-Power Devices

An Explanation and Discussion of the Necessary Components of Such Apparatus, and the Types of Each Most Desirable

By Herndon Green

IF an investigation were made, of the various steps which have been taken in the progress and development of radio receiving sets, an interesting story would unfold itself. Even our now-commonplace "B" battery has behind it some interesting history which, to the majority of broadcast listeners, is unknown.

Toward the end of the crystal-detector era, when attention was turning to the de Forest bulb and the audiotron, there was no such unit as a 22½- or a 45-volt "B" battery. A set-builder who was so bold as to employ one of these new-fangled tubes relied chiefly on a bank of 4½-volt flashlight cells for his plate supply. Today we have quite efficient heavy-duty "B" batteries; but still the quest goes on for something in the line of "B" power-supply devices with which to obtain "B" potential for the tubes in a radio receiver, via the light socket.

The last few years have seen great strides of progress in the "B" socket-power field. In fact, the advance has been so rapid as to leave the majority of listeners-in without an understanding of the principles embodied in these devices; with the result that unscrupulous manufacturers and dealers have unloaded on an unsuspecting public a great deal of worthless and useless junk labeled as "B" power-supply apparatus. It is the aim of this article to acquaint the readers of Radio News with a simple, non-technical explanation of the function of the component parts of a representative "B" power-supply device.

THE HOUSE CURRENT

If our houses were powered with direct current, of say, 180 or 220 volts, there would probably be no need for any more complicated device than a smoothing or filter device and a voltage divider; so that various lower values of voltage might be obtained in addition to the voltage value of the house supply. (An assembly of similar nature was described in Radio News for January, 1927). However, in only a few sections of the country is direct current available, and then it is usually not of sufficient voltage to be useful as a "B"-battery substitute. Alternating current is decidedly cheaper to distribute than direct; but with alternating current we encounter a number of conditions which make its ultimate use for powering a receiver somewhat complicated.

The voltage that is supplied to the plates of radio vacuum tubes must be of a direct-current nature, be steady in value, and free of pulsations that produce hum. Alternating current is usually considered as steady in value, not fluctuating appreciably; but it is not of direct-current nature and it does produce considerable hum. Therefore, in utilizing alternating current for a "B" substitute, a number of electrical changes must take place before it is satisfactory for use.

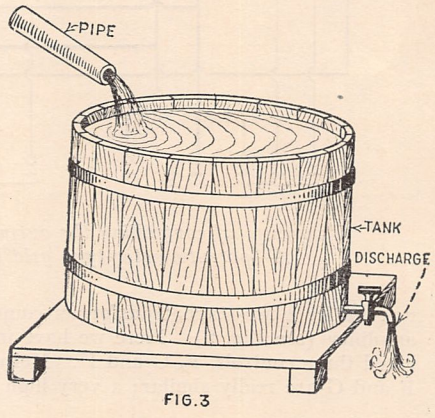


FIG. 3

The action of a filter unit may be likened to that of a system comprising a pump, a tank and a discharge tap. The tank stores up the periodic charges and discharges them in a steady stream.

In the first place, the line-voltage of a house supply is usually too low for immediate use. When a receiver employs a power tube of the 171 variety, at least 180-volt "B" potential is desirable and a 40.5-volt "C" battery is employed. To obtain both the "B" and "C" voltages from a "B" power-supply device is not difficult; yet immediately we see that at the output of the device at least 220 volts are required. Since this is just double the value of the line or house voltage, a transformer unit is employed to "step up" this line voltage. Engineers can, by calculation, determine the electrical and physical dimensions of a transformer that will step up the line voltage to a predetermined value. Now, one step of progress has been made toward the ultimate goal, that of changing the low-value alternating-current to a higher value, suitable for use as "B" supply. Yet, even in its stepped-up state, the alternating current is not immediately suitable for use. It is necessary to change the A.C. to D.C., this operation being accomplished by a "rectifier" unit (see Fig. 1).

SMOOTHING OUT THE CURRENT

Rectifiers may roughly be divided into three classes: chemical, gaseous and thermionic. While they operate somewhat differently, they produce the same general results, and have the same purpose; that is, they pass current in one direction only, thereby changing an applied A.C. to a pulsating D.C. While rectifiers generally take the form of one of the three types mentioned, it is possible that any of these three may be of the "full-wave" or the "half-wave" type of rectifier. In the half-wave rectifier only half of the alternating-current impulses is used, as illustrated in Fig. 2A. In the full-wave type of rectifier tube, the elements are so arranged within the tube as to utilize that half of the wave unemployed in the half-wave type of tube; with the result that the number of pulsations in the resulting direct current is doubled; thus making the job of "filtering" not so difficult.

Still, this pulsating direct current is not ready for use. The pulsations would produce a disagreeable hum in the loud speaker; so it is necessary to smooth them out. The unit used for this purpose is called a "filter" and consists of large choke coils and large fixed condensers. The choke coils have the property of retarding the flow of alternating or pulsating current, but quite readily pass direct current; while the condensers act as a storage tank or reservoir, so that the current may build up to a usable value and not immediately dissipate itself, as would be the case if these condensers were not included in the circuit. The action of the filter unit might very well be likened to a tank, which receives at its top a series of charges of water from a pump. The tank stores up these periodic charges and then, through an outlet at its bottom, discharges the water in a strong, steady stream (see Fig. 3).

Three of the four necessary steps have

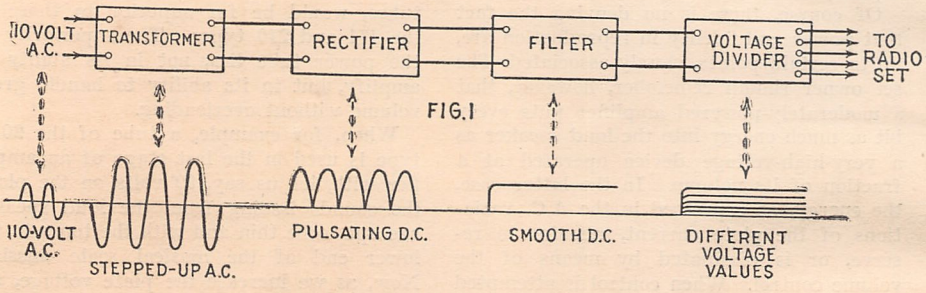


FIG. 1

FIG. 2

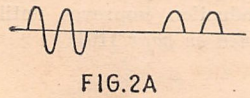
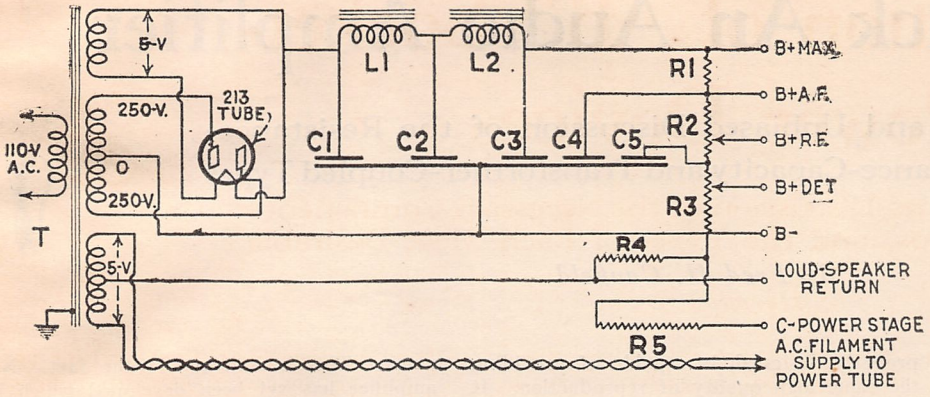


FIG. 2A

Fig. 1 shows the various instruments for preparing the needed D.C. for the plates of tubes. Beneath, in Fig. 2, the changing of the waves is shown, diagrammatically. Fig. 2A illustrates half-wave rectification.



T = LINE TRANSFORMER
L1,L2 = 30-HENRY CHOKES
C1 = 4 MF.
C2 = 4 MF.
C3 = 6 MF.
C4,C5 = 1 MF.

R1 = 2000 OHMS
R2 = 5000 "
R3 = 5000 "
R4 = 2000 "
R5 = .05 MEGOHM

FIG.6

In this schematic diagram we have indicated the use of a thermionic rectifier tube for converting the A.C. to pulsating D.C. Appropriate circuit constants are given.

now been described. That is, the original 110-volt alternating current has been stepped-up, it has been rectified or changed to a pulsating direct current, and finally it has had these pulsations eliminated or ironed out by means of a filter system; leaving only pure, non-pulsating direct current of the correct voltage value.

DIVIDING THE VOLTAGES

Now if only one value of "B" voltage were required by a receiver, the job would end here; but the various tubes in a receiver require different values. For instance, the radio-frequency amplifier tubes may require 67 or 90 volts; the detector may operate most satisfactorily at 45 or 67 volts; the first audio amplifier may take 90 volts and the final or power stage may require 135 or 180 volts—depending on whether a 112 or a 171 type of tube is employed here. Therefore, it becomes necessary to utilize the maximum output of the "B" power-supply device in order to make possible the use of these intermediate values of voltage. This is best accomplished by means of a series of fixed or variable resistors located in the circuit, directly across the output terminals of the filter section.

It is one of the laws of electricity that, if a resistance R be placed across a source of voltage, E, as in Fig. 4, any intermediate value of voltage (Es) can be obtained. This will vary from zero to maximum volts, depending upon the position of the movable contact arm C; it will be least when this arm is brought nearest to the negative side of the output. This "potentiometer" principle is applied in the "voltage-divider" units employed in "B" power-supply devices; with the addition that, not alone one contact arm, but as many as there are intermediate voltages required are used. Usually the resistance does not consist of one unit but of several individual units, as shown in Fig. 5.

THINGS TO SEE TO

To recapitulate: there are a number of requirements which the several units comprising a "B" power-supply device must possess. In the matter of the transformer, one should be selected that is well made, mechanically, and has sufficient windings, not only for the "B" supply, but also for the rectifier tube (should the latter be of the filament type), and for the filament of the power amplifier tube.

The rectifier tube should have a guaranteed life of 1,000 hours or more; it should have the proper current rating in milliamperes to insure its suitability for use with the other apparatus employed. Nowadays it is possible to purchase rectifier tubes which are entirely satisfactory for use in "B" power-supply devices and have current ratings ranging from 85 milliamperes to 300 and 400 milliamperes; the latter type is suitable for "A" or filament-current supply.

In the filter unit, caution must be exercised in choosing the condensers and chokes which go to make up this very important part of the complete device. The chokes should have a sufficient current-carrying rating, in excess of what will ultimately be drawn from the "B" device, so that at no time is its carrying peak reached. When the current rating of a choke is exceeded it rapidly decreases in inductance value, and does not then measure up to the requirements of a satisfactory choke.

High operating-voltage rating of the filter condensers is essential to the successful operation of a "B" power-supply device. Here again, as with every part of the device, reliable apparatus should be employed. A rating of 600 volts, D.C., for the condenser nearest the rectifier part of the circuit is not too great, and lower operating-voltage values for this particular condenser should be avoided. The condensers in the remainder of the filter circuit may be of the 400-volt rating.

In the voltage divider, we are presented with the problem of selecting resistance units that are constructed in such a manner that they will not only carry the maximum current under full load but also dissipate the heat generated by the passage of the current through them. There are a number of types of resistor now obtainable, which fall generally into two classes: (1) the wire-wound type; and (2) the carbon-compression type.

In summarizing, we find that all A.C. "B" power-supply devices can be analyzed as follows: first, there is a transformer which steps up the line voltage to a value in excess of what will ultimately be employed at the output (this high starting voltage is necessary because of voltage "drops" in the rectifier and filter systems); secondly, there must be a rectifier, of either the half- or full-wave type, which converts or changes the stepped-up alternating current into pulsating direct current; thirdly, there is a filter system which smooths out the pulsations and acts as a storage tank or reservoir; and fourth, there is a voltage-divider system wherein the use of variable or tapped resistors makes available intermediate values of output voltage, satisfactory for application to the plate of the different tubes in a radio receiver.

In Figs. 6 and 7 are shown representative "B" power-supply circuits, employing the thermionic and gaseous types of rectifiers.

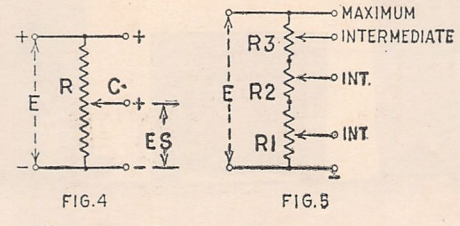
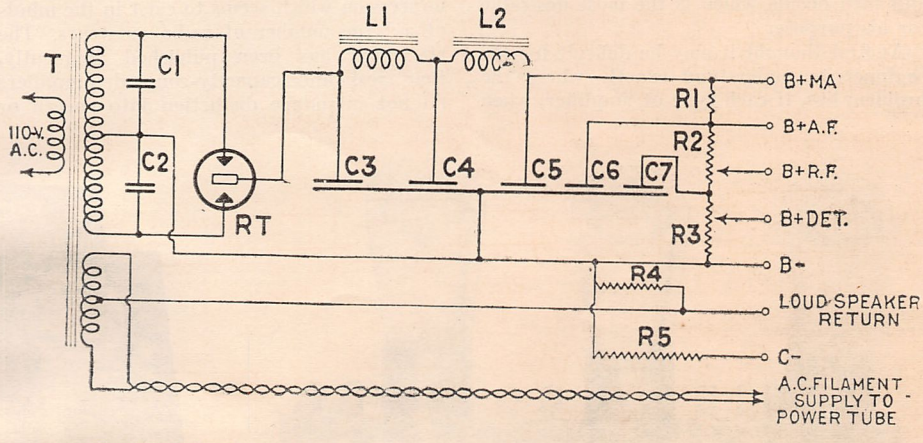


FIG.4

FIG.5

These two diagrams illustrate how different voltages are obtained from the maximum output of the rectifier.



T = LINE TRANSFORMER
L1,L2 = 30-HENRY CHOKES
RT = 85-MILLIAMPERE RECTIFIER TUBE (FULL-WAVE)
C1,C2 = .1MF. BUFFER CONDENSERS
C3,C4 = 2 MF.
C5 = 8 MF.

C6,C7 = 1 MF.
R1 = 2000 OHMS
R2 = 5000 "
R3 = 5000 "
R4 = 2000 "
R5 .05 MEGOHM

FIG.7

A gaseous tube, RT, is the rectifier used in this "B" socket-power unit. Appropriate values for all parts are given.

How to Pick An Audio Amplifier

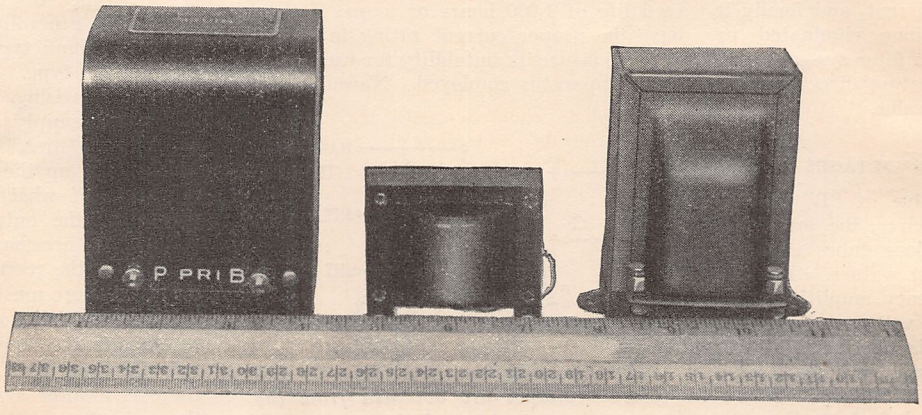
An Elementary and Unbiased Discussion of the Resistance-Capacity, Impedance-Capacity and Transformer-Coupled Types

By Fred H. Canfield

AUDIO-FREQUENCY amplifiers fall into three principal classes, viz.: transformer-coupled, resistance-capacity-coupled and impedance-capacity-coupled, or combinations or modifications of these three types. During the past few years newspaper radio sections and other radio periodicals have published much propaganda in favor of and against each of the three systems; with the result that the general public is greatly confused on all matters concerning the subject. In this article no attempt will be made to give a definite solution to the riddle, "What is the best type of audio amplifier?"; but the writer will endeavor to point out the desirable and undesirable characteristics of each arrangement. This information should aid the reader in deciding the particular combination of instruments which will best satisfy his requirements.

In the first place, it should be explained that it is impossible to say that one basic audio-amplifier circuit is better than another, as every amplifier has limitations or features which may be considered objectionable. On the other hand, with any one of the three types described in this article, it is possible to obtain reproduction which is practically perfect, provided the amplifying units have been correctly designed by an experienced engineer. It is, therefore, necessary for the set builder to sum up all the facts he can learn about each amplifier and then decide which is the most desirable for his purpose.

At first thought it may be difficult for the beginner to understand exactly where the problem lies, if each type of amplifier, when properly designed, is capable of providing the same high quality of reproduction. It should be explained that there are such questions as first cost, efficiency, ease of construction, etc., which should be considered. For an example, compare the resistance-capacity-coupled amplifier with the standard transformer-coupled amplifier. In most cases the first cost of the former is much less, but the efficiency per tube of the latter is much greater. Therefore, it may be seen that in this particular instance it is necessary for the owner to decide which is the more desirable feature. But these



Three different types of audio transformers are shown in the above illustration. The two large units are of modern design and are highly efficient, while the one in the center is typical of the old-type instruments, which were small and inferior.

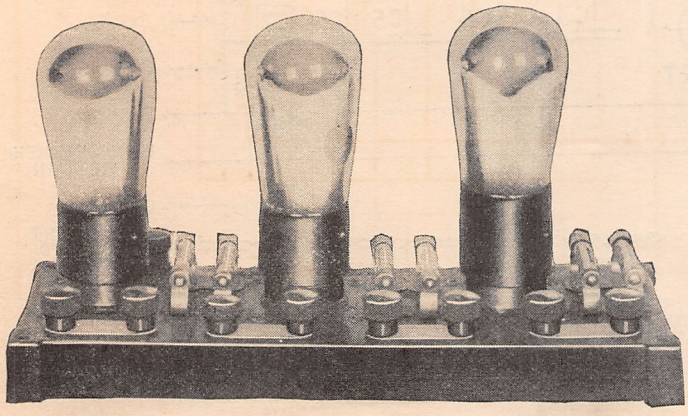
are not the only questions which must be taken into account.

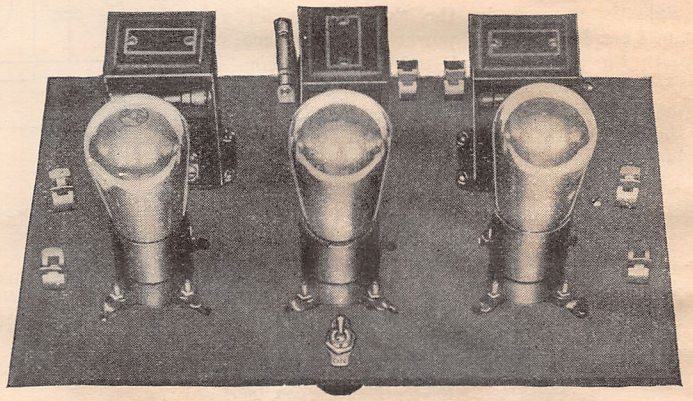
DISTORTION NEVER ABSENT

Before continuing further with this discussion, the writer wishes to correct one impression which seems to exist in the minds of a large number of radio amateurs. The statement has been published frequently, that resistance-capacity-coupled amplifiers do not introduce distortion into speech or music. This is contrary to the fact. No amplifier has yet been developed which is *entirely free from distortion,* even though the actual amount has been reduced to a very low minimum in some instruments. In the case of the resistance-capacity-coupled amplifier the fact, that the resistor units are impartial to the frequency of the currents they amplify, is probably responsible for the "distortionless" claim, but two other possible causes of distortion remain. First, the impedance of the *coupling condensers* varies inversely with the frequency of the current and as a result the low notes are not amplified at full volume; and second, the tube will introduce distortion if it is not operated with the correct bias applied to the grid. Also, overloading any stage of this amplifier will cause distortion, just as in any amplifiers of other types.

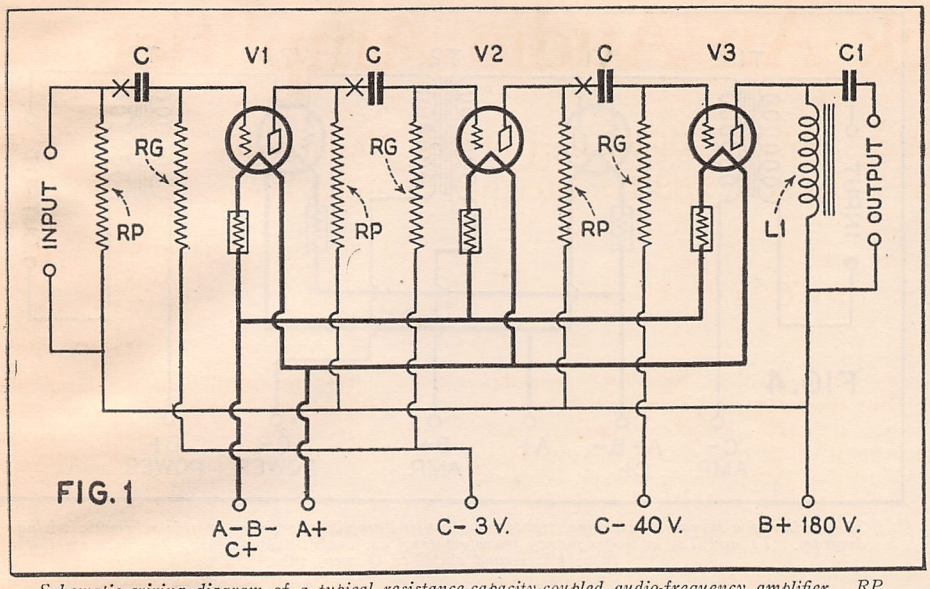
Another false impression which the advocates of resistance capacity-coupled amplifiers have tried to establish is that a transformer-coupled amplifier *must* cause distortion. This is true in the strict meaning of the word, but the authors of the statement tried to create the understanding that the distortion in such units is always excessive. The fact is that, under ideal conditions, the reproduction would be so natural that any further improvement could not be detected by the human ear.

Now that a few facts about amplifiers in general have been made clear the different types of amplifiers may be considered separately. In Fig. 1 there is shown the schematic wiring diagram of a standard resistance-capacity-coupled amplifier. The circuit shown employs three stages, which is





The amplifier illustrated at the left is a standard, factory-built, three-stage, resistance-capacity-coupled unit. At the right is shown a typical, home-made, impedance-capacity-coupled amplifier. Both units are small in size and furnish very satisfactory reproduction.



Schematic wiring diagram of a typical resistance-capacity-coupled audio-frequency amplifier. RP, plate resistors; RG, grid resistors; C, coupling condensers; V1 and V2, "hi-mu" tubes; V3, power tube; L1-C1, output filter.

the number usually required for loud-speaker volume.

In circuit arrangement the resistance-capacity-coupled amplifier is very simple. The plate voltages for the first two amplifier tubes (V1 and V2) and the detector tube are applied through three resistors (RP). The plate of one tube is coupled to the grid of the tube in the next stage by means of a condenser (C), which prevents the plate potential from being applied to the grid. The resistors RG in the grid circuit of each tube complete the circuit between the grid and filament and make it possible for the grid charges to leak to the filament.

Although the circuit of the resistance-capacity-coupled amplifier is not in the least complicated, the selection of the proper sizes of resistors and coupling condensers, and the use of the proper kind of tubes, is highly important. If the various pieces of apparatus used in the amplifier are not suited to the respective purposes for which they are used, the amplification will be very low or the reproduction will be very unsatisfactory.

RESISTANCE VALUES

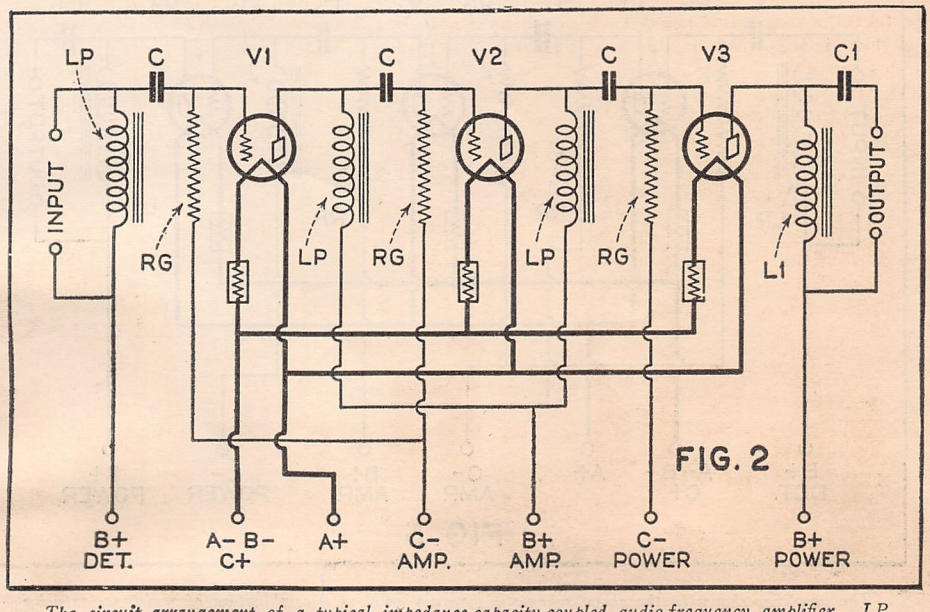
In the first place it should be explained that the amplification obtainable from this type of amplifier depends entirely upon the amplification factor ("mu") of the tubes employed. For this reason the 201A-type tube with an amplification factor of 7 is not entirely satisfactory, and a tube of the 240 type, with an amplification factor of 30, should be selected. Secondly, the plate resistors should have as high a resistance as possible and *in no case should the value of these resistors be less than the plate resistance* of the tube. In the case of the 240 tube the plate resistance is 150,000 ohms and, in order to obtain satisfactory amplification, the plate resistor must have a resistance of at least 250,000 ohms. A third important factor is the selection of the proper plate voltage. Because the resistance of the plate resistor is always greater than the plate resistance of the tube, more than 50% of the plate voltage is wasted in the plate resistor. Therefore, it is imperative that a high voltage be applied to the resistor, in order that the plate shall receive sufficient potential for the efficient operation of the tube. In the case of the 240 tube, with a 250,000-ohm plate resistor, the plate potential should be 180 volts. Under these conditions a grid bias of 3 volts is required.

Probably the most important problem in the design of a resistance-capacity-coupled amplifier is that of the proper values for the coupling condenser and the grid resistor. In this connection there are three things which must be remembered: first, distortion is reduced as the *capacity of the coupling condenser is increased;* second, the amplification is increased as the *resistance of the grid resistor is increased;* and third, as the values of the coupling condenser and grid resistor are increased, a *time lag* tends to destroy the utility of the amplifier. The time lag is caused by the fact that the grid resistor is unable to discharge the coupling condenser rapidly enough when loud signals are being received and, as a result, the grid becomes blocked.

From the above it may be seen that two conflicting conditions exist which prevent the amplifier from delivering perfectly distortionless reproduction. Of course, the ideal solution would be to eliminate the coupling condenser and grid resistor from the circuit entirely and substitute a "C" battery of the proper voltage at the point marked X; but, as the voltage of the "C" battery would have to be equal to the voltage applied to the plate of the preceding tube, plus the potential required for biasing the grid, this is an impractical arrangement. Therefore, it is usually necessary to select for the coupling condenser a value which does not cause too much distortion, and then to use a grid leak which gives most satisfactory results. The value of the condenser may be as high as 0.1 mf. if great volume is not required from the receiver; but when it is desired to operate a loud speaker with good volume it may be necessary to reduce the capacity of the condenser to .01 mf. The size of the grid resistors must be determined by experiment and the highest value which gives satisfactory results on loud signals should be selected. In many cases it will be found that best reproduction is obtained when a comparatively high resistance is used in the first stage, a lower resistance in the grid circuit of the second stage and a much lower resistance in the grid circuit of the power tube. The value of the resistors may vary from 2 megohms to 500,000 ohms.

ELIMINATING R.F. EFFECTS

In operating resistance-capacity coupled amplifiers there are several things which should be remembered. In the first place, amplifiers of this type amplify radio-frequency currents just as well as audio-frequency currents and, to prevent the tubes from being overloaded with R.F. potentials, it is essential that a radio-frequency choke coil shall be connected in the plate circuit of the detector tube. Also, a small by-pass condenser (approximately .002 mf.) should be connected between the detector plate and the filament. Secondly, if a power tube of the 210 or the 171 type is used in the last stage, an output filter or output transformer of some type should be connected in the plate circuit to protect the windings of the loud speaker from the large value of plate current used by the power tube. Thirdly, an efficient source of "B" supply must be employed and, if a "B" power unit with a high output resistance is used, special precautions must be taken to prevent "motorboating." These are discussed later.



The circuit arrangement of a typical impedance-capacity-coupled audio-frequency amplifier. LP, plate impedance units; RG, grid resistors; C, coupling condensers; V1, V2 and V3, vacuum tubes; L1-C1, output filter.

Lastly, best results will usually be obtained when a 240-type tube is used in the detector circuit with a plate potential of 180 volts and a grid bias of 4½ volts.

To conclude the discussion of resistance-capacity-coupled amplifiers it may be said that they are capable of providing excellent reproduction when properly designed, and the total cost is considerably less than that of other types of amplifiers. However, they are not foolproof in operation, as there are many factors which may cause severe distortion. Usually they require more stages than does a transformer-coupled amplifier, to produce a given amount of volume. In operation these amplifiers are most satisfactory where large volumes are not required. Also, the tubes in the resistance-capacity-coupled amplifiers require a higher plate potential for their operation.

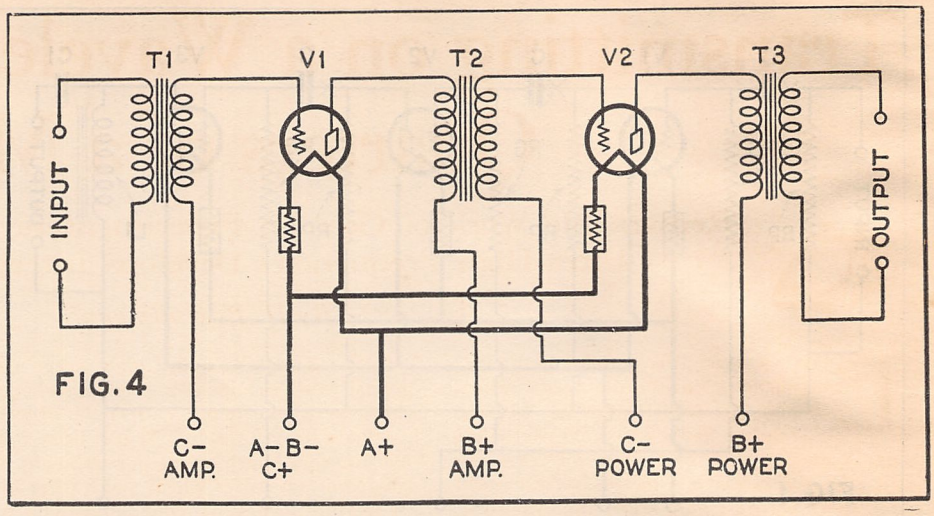


FIG. 4

The wiring of a standard two-stage, transformer-coupled amplifier is shown in this schematic wiring diagram. T1 and T2, audio-frequency transformers; T3, output transformer; V1, first amplifier tube; V2, second amplifier (power) tube.

CHOKE-COIL COUPLING

In Fig. 2 will be found the wiring diagram of a standard impedance-capacity-coupled amplifier. From the circuit it may be seen that it is very similar to the resistance-capacity coupled type, the only difference being that audio-frequency choke coils (Lp) are connected in the plate circuits of the stages in place of the resistors used in the resistance-capacity-coupled amplifier. In operation this amplifier is very similar to the resistance-coupled type, but it is more economical as to plate voltage; as the large voltage drop across the plate resistors is obviated by the substitution of choke coils. It is also easier to obtain a degree of amplification which closely approaches the amplification factor of the tube than with resistance-capacity coupling. This is because, in a resistance amplifier, the value of the plate resistors must be several times the output impedance of the tube before the amplification of the stage approximates that of the tube.

In the impedance-coupled amplifier the audio-frequency choke coils vary in impedance with the frequency of the current which they amplify, and as a result the amplifier gives slightly better results on high notes than on low frequencies. However, if the impedance of the audio choke coil at the lowest frequency which it is to amplify is three or four times as great as the output resistance of the vacuum tube, the distortion from this cause is not serious. Choke coils which have an inductance of 100 henries or more are satisfactory when using the 201A-type tubes. With the impedance-capacity-coupled amplifier the difficulty in obtaining a satisfactory value for the coupling condensers and the grid resistor is identical with the problem in the resistance-capacity-coupled amplifier.

From the above it may be seen that the impedance-capacity-coupled amplifier is almost identical with the resistance-capacity-coupled amplifier in operation, circuit design and construction, and produces very similar results. It will give equal results with lower values of plate voltage, but the parts used in its construction are slightly more expensive. When operating the impedance-capacity-coupled amplifier in connection with a plate-power-supply unit one is apt to experience a "motorboating" effect unless provision has been made to guard against it in the design of the amplifier or the power unit.

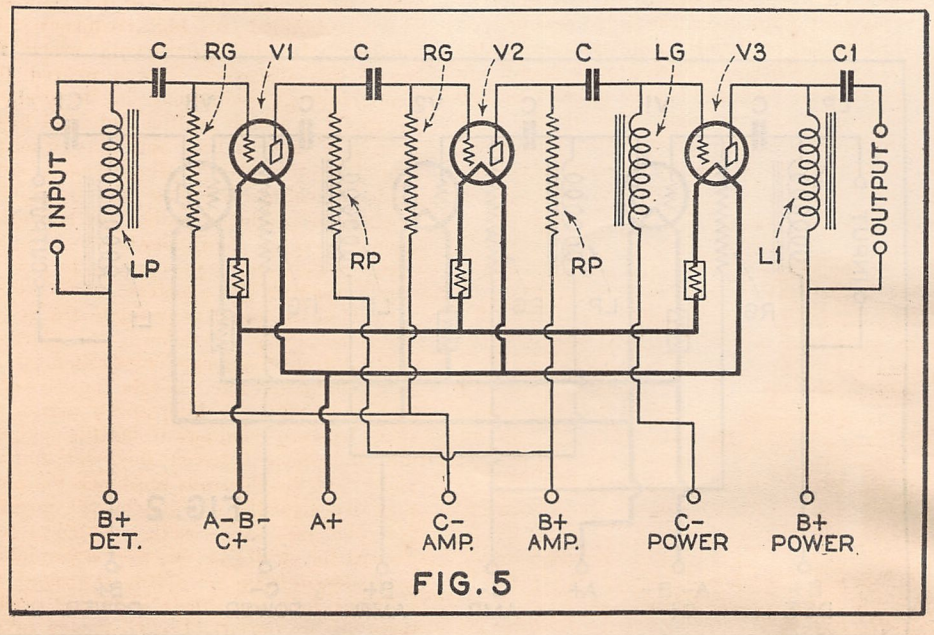


FIG. 5

The amplifier shown in the above schematic diagram employs a combination of resistance-capacity and impedance-capacity coupling which proves very satisfactory. "Motorboating" is usually absent in this circuit.

"MOTORBOATING"

"Motorboating," probably more than any other single factor, has prevented amplifiers of the resistance-capacity- and impedance-capacity-coupled types from achieving greater popularity than they have done. It may be described as a form of interference, heard in the reproduction, which sounds like the exhaust of a motorboat's engine. It is most annoying and sometimes ruins reception. It is seldom heard if the amplifier is supplied with a plate potential obtained from batteries, but is very frequently the cause of unsatisfactory results when an inefficient socket-power unit is used. The elimination of the "motorboating" effect puzzled radio experimenters for a long time, but several methods have been found for overcoming the disturbance.

Motorboating can frequently be eliminated by correcting the design of either the amplifier or the socket-power unit; but the most satisfactory method is to attack the trouble at the source, the socket-power unit. It has been found that socket-power units which have a low output resistance and an adequate filter, and which provide a constant voltage, do not cause "motorboating." Also, it has been found that by the use of an 874-type (voltage-regulator) tube in the output circuit of a socket-power unit, the current may be made constant and the output resistance may be reduced at the same time. The problem of improving the filter need not be discussed, as this is merely a matter of selecting efficient apparatus. If it is desired to make changes in the amplifier, a 3-henry choke coil, connected in the plate-supply lead of each stage, often produces the desired effect. If the choke coils do not entirely eliminate the trouble, the use of an impedance leak in place of the grid resistor in the last stage often improves results. Sometimes it will be found that, by alternating between stages of resistance-capacity- and impedance-capacity-coupled amplification, one can obtain even better performance. A typical combination of this kind is shown in Fig. 5.

While on the subject of impedance-capacity-coupled audio amplifiers, it should be pointed out that there is a variation of the circuit which makes it possible to obtain an amplification greater than the amplification factor of the tube, and still retain the advantages of this type of amplifier. The

(*Continued on page* 1162)

Transmitting on a Wavelength of Three-Quarters of a Meter

Remarkable Work of German Fxperimenters With Radiophone on Ultra-High Frequencies Develops Interesting Circuits

*By H. E. Hollmann**

LOW wavelengths" and "high frequencies" are radio terms which may be considered as entirely relative, as they have no particular significance of their own. Several years ago all channels below 600 meters were classed as "short waves"; and, when the American radio law of 1912 was passed, the legislators thought that the amateur transmitter could be eliminated by assigning stations of this class to wavelengths below 200 meters, as this field was considered valueless. When broadcast stations started operating on waves near the amateur band, the amateur was forced to use still shorter wavelengths; and at that time it was discovered that satisfactory results could be obtained on less than 100 meters. Later amateurs found that waves as low as 40 meters provide valuable channels for communication.

Today there are many high-power commercial stations operating on wavelengths which were considered entirely impractical less than six years ago. It has been found that the very short waves possess many unusual characteristics which make them ideal for certain types of communication, particularly over long distances. In addition to the stations which are actually operating on short waves, there are hundreds of experimenters endeavoring to obtain data on the *ultra-short* wavelengths which have not yet shown their commercial value.

While engineers are busy trying to find some commercial use for the wavelengths below 13 meters or so, scientists are still seeking shorter wavelengths to conquer. In this field the latest development is a new transmitter which operates on a wavelength of 75 centimeters (*three-quarters of a meter, or 29½ inches*). Of course, no practical use has yet been found for such a transmitter, but the inventors of the system are very much pleased with the fact that they have been able to produce oscillations at such high frequencies, and are equally elated over the development of a receiver which will detect the oscillations. Not only have they been able to transmit and detect continuous-wave signals on a wavelength of 75 centimeters, but they have been able to send and receive I.C.W. (interrupted continuous wave) and even telephone signals on these high frequencies. These signals have been received over distances of approximately a quarter of a mile.

PRINCIPLES UTILIZED

In this article no attempt will be made to give constructional details of a receiver or transmitter for operation on 75 centimeters, but the experiments with this apparatus which have been conducted in Germany will be described for the benefit of the qualified experimenter who may wish to do some original research work with ultra-short wavelengths. However, it must be remembered that the results described were obtained with foreign equipment and, therefore, entirely different results may be obtained from American tubes and apparatus.

Two German radio engineers, Barkhausen and Kurz, are responsible for the first research work attempted in this direction. The discovery which pointed to the possibility of operating radio apparatus on wavelengths of less than one meter came as a result of a study of the characteristic curves of vacuum tubes. It was found that in these graphs certain irregularities appear, which are similar to the resonance curves obtained in high-frequency phenomena. In the experiments which followed this discovery it was proved that high-frequency oscillations can be produced by applying a high positive potential to the *grid* of a vacuum tube and a *negative* potential to the plate. Measurements were made which showed that the oscillations which were produced in this way had a frequency *greater than one hundred million cycles per second,* corresponding to a wavelength less than three meters.

Barkhausen and Kurz explain the results described above as follows: the electrons emitted from the incandescent filament are so strongly attracted by the positive grid that they move at high speed across the space between the filament and the grid, and into the space between the grid and the plate. As the electrons approach the plate, they are strongly repelled by the negative potential and, as a result, are driven back toward the grid. In this way a pendulum-like movement is established around the grid; or in other words, electrical oscillations are produced. The frequency of the oscillations has been found to be governed by the characteristics of the vacuum tube and the value of the plate and grid poten-

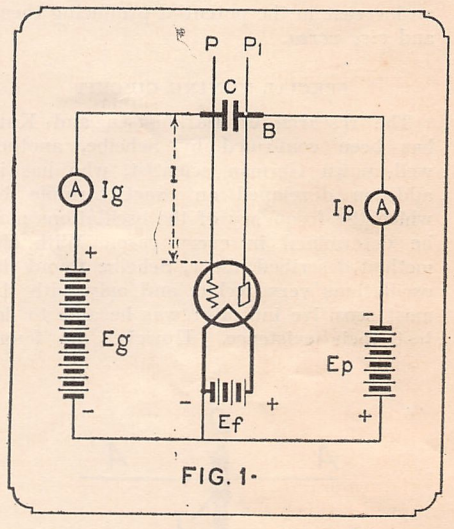


FIG. 1.

The 75-cm. resonant circuit comprises only the parallel wires of length (l) varied by the sliding bridge B, and the tube's internal capacity.

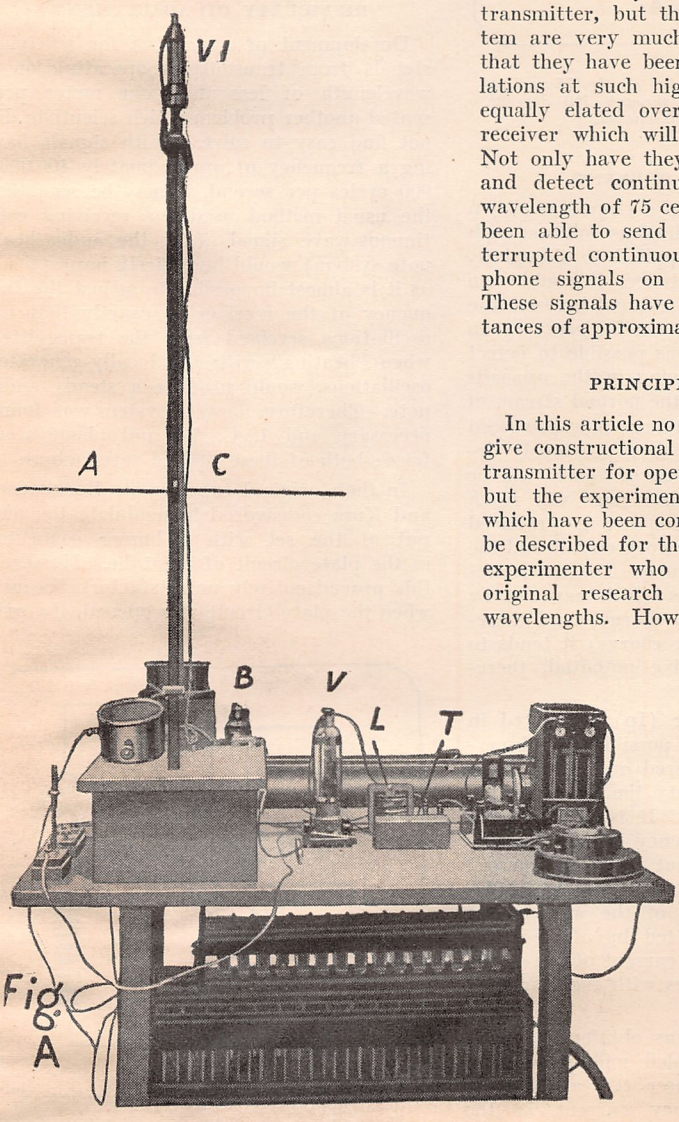
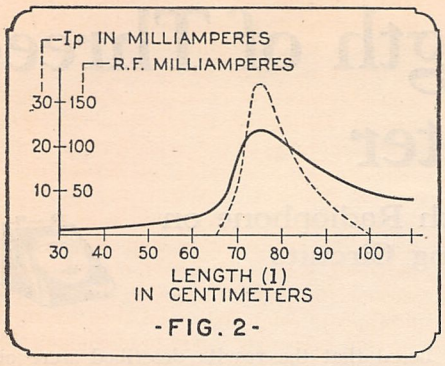


Fig. A

The telescoping horizontal rods A form the only aerial of the 75-centimeter radiophone transmitter at the left; they are slid up and down the vertical mast to decrease or increase the length of the parallel wires included in the oscillatory circuit of the tube V1, and connecting the latter with its batteries.

* *Physical Institute of Technology, Darmstadt, Germany.*



-FIG. 2-

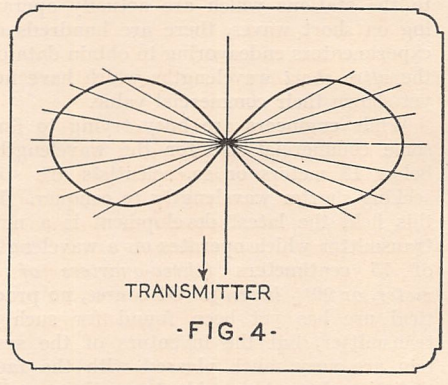
Maximum plate current in the 75-cm. transmitter practically coincides with maximum oscillatory current; thus making tuning possible.

tials. The oscillations are accelerated by an increase in the potential producing them, and *vice versa.*

SPECIAL TUNING CIRCUIT

The research of Barkhausen and Kurz has been confirmed by Scheibe, another well-known German scientist, who has in addition developed an exact formula by which the frequency of the oscillations may be determined in every case. With the method described above, Scheibe found the oscillations very feeble, and only with the most sensitive indicator was he able to detect their existence. However, he found that by connecting a closed oscillatory circuit to the tube it is possible to obtain a considerable increase of energy.

The circuit which he used for this purpose is shown in Fig. 1. Two parallel wires (P and P1) are connected to the grid and plate terminals of the tube, and these wires are connected by a sliding bridge, B. The grid-plate capacity of the vacuum tube, plus the inductance of the two parallel wires, composes the closed oscillatory circuit, which may be adjusted to the desired frequency by the sliding bridge. The grid and plate potentials are brought to the tube through the parallel wires and the by-pass condenser (C) is used to prevent a short-circuit of these power-supply wires. Because of its relatively large capacity, the presence of the condenser in the bridge has little or no effect upon the high-frequency circuit.



-FIG. 4-

A graph of the sensitivity of the 75-cm. antenna as it is revolved through 360 degrees. It is very directional.

A TWO-WAY CURRENT

The operation of such a circuit as shown in Fig. 1 may be explained as follows: with a negative potential applied to the plate, under ordinary circumstances, it would seem that there should be no current between the plate and the filament. On the contrary, in a poor vacuum tube it is possible to detect an *"ionic"* current flowing in the *opposite direction* from that of the normal stream of electrons. If oscillations are now produced in the tube, in the manner previously described, a positive stream of *"ions"* will be found to exist; and this stream will reach its maximum when resonance is produced between the outer oscillatory circuit and the oscillations inside the tube. The ion represents a particle of gas which has lost an electron (unit negative charge) and therefore has a unit positive charge; it tends to move toward a negative potential, therefore.

With a milliammeter (Ip) connected in the plate circuit, it is possible, by observing the current registered on the scale, to determine with certainty the best position for the sliding bridge. It is possible also to measure the frequency of the oscillations. Fig. 2 shows that the plate current of the tube (the solid line of the graph) varies with the length of the wire in the bridge circuit. The dotted line of the graph indicates how the R.F. current of the closed oscillatory circuit varies with the length of wire in the bridge.

This measurement was obtained by connecting a thermo-coupled milliammeter in series with the condenser (C) and in this way the high-frequency current in the bridge circuit was directly measured. By comparing the two curves of the graph, it may be seen that the maximum intensity of oscillations is approximately at the point of maximum plate current. Therefore, by adjusting the bridge until maximum plate current is obtained, it is possible to determine the frequency of the oscillations by measuring the length of wire in the bridge; and, at the same time, be assure of maximum intensity of oscillations. The curves shown were obtained with a Schott transmitting tube (type N) under a plate potential of 240 volts.

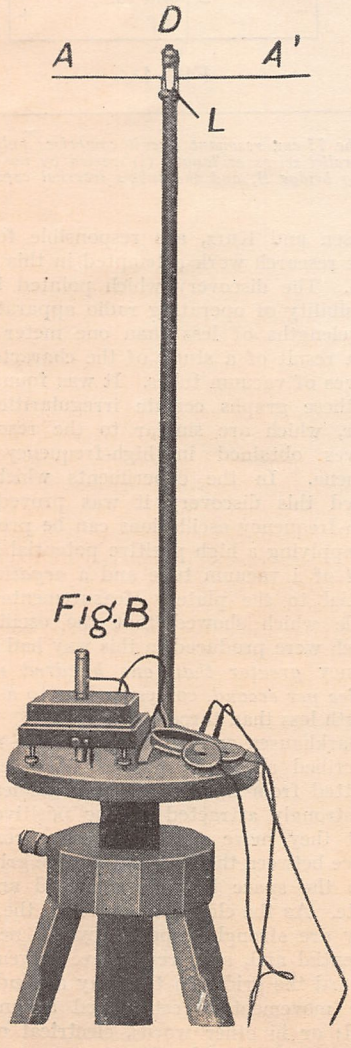
USE FOR TRANSMITTING

In order to convert the oscillator described above into a short-wave transmitter, it is necessary only to connect a bi-polar antenna to the bridge in the proper manner (see Fig. A). Such a transmitter will send out a considerable amount of energy, and, with proper modulation, will serve for radio telephony. The bi-polar antenna consists of two straight wires (each half as long as the wave produced), which are fastened directly to the bridge in a horizontal position, in the manner shown in the pictures accompanying this article. In Fig. 3 the complete schematic wiring diagram of a transmitter of this type is given. The bi-polar antenna is shown at A and is connected directly to the bridge C. The two inductors in the filament circuit are choke coils which prevent undesired self-oscillations.

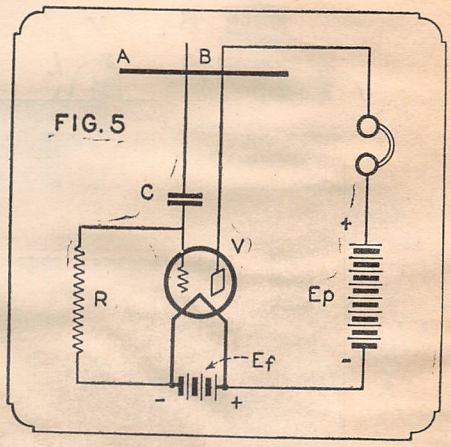
DIFFICULTY OF ADJUSTMENT

Development of apparatus for receiving signals from transmitters operating on a wavelength of less than one meter presented another problem which scientists did not find easy to solve. With signals having a frequency of approximately 400,000,000 cycles per second, it may be seen that the usual method used for receiving continuous-wave signals (*i.e.*, the audio beat-note system) would be entirely impractical; as it is almost impossible to adjust the frequency of the receiver so exactly that the oscillations received from the transmitter, when "beating" with the locally-generated oscillations, would produce a steady audio note. Therefore, another system was found necessary and I. C. W. and phone were tried; both of these proved satisfactory.

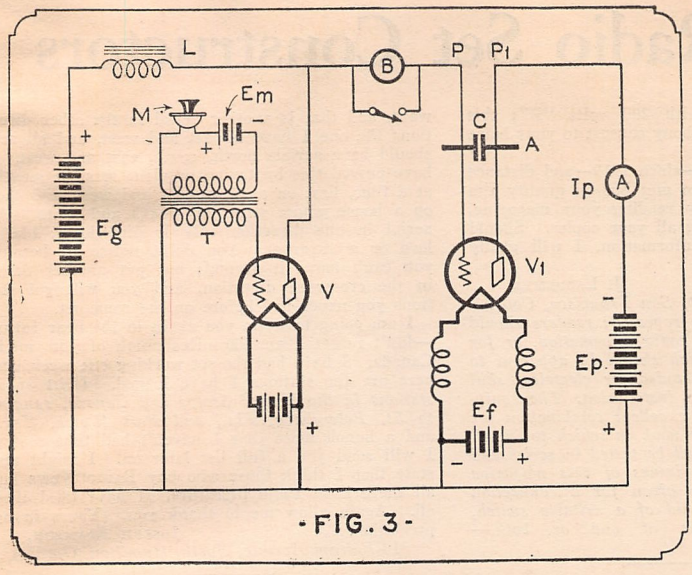
In their original experiments Barkhausen and Kurz endeavored to modulate the output of the set with a buzzer connected in the plate circuit of the tube. However, this proved entirely unsatisfactory because, when the plate circuit was opened, the grid



A 75-cm. receiver of the simplest type, with crystal detector D, and sliding bridge A-A1. L are R.F. chokes; the phone leads are inside the vertical rod.



The circuit of the 75-cm. vacuum-tube receiver pictured in Fig. C.



- FIG. 3 -

The accompanying circuit diagram contains the details of a transmitter operating on 400,000 kilocycles, or ¾-meter (75 centimeters), and capable of sending phone or I.C.W. (buzzer) signals. It will be seen that there is a NEGATIVE *voltage on the plate and a* POSITIVE *on the grid; and the modulation system is unusual. These peculiarities are necessitated by the unusual conditions encountered at such enormously high frequencies.*

received the entire emission current and, as a result, quickly overheated. In Fig. 3 the buzzer (B) is shown connected directly in the grid circuit and this has been found to be very efficient.

Barkhausen and Kurz also attempted to modulate their transmitter for telephone, but the results have been more or less unsatisfactory. A modulation transformer was used to replace the buzzer in the plate-supply wire, and a microphone was connected in series with the primary winding. This method, however, modulates only a small percentage of the output.

TELEPHONE WORK

The only experiment which has given satisfactory results employed a circuit such as is shown in Fig. 3, in which an extra tube is used as a modulator. In this circuit the fluctuating current of the microphone (M) is carried through the microphone transformer (T) to the grid of the modulating tube (V) and this changes the internal resistance of the tube so that low-frequency potential variations exist in the choke coil (L). As a result, the grid potential of the transmitting tube (V1) is increased and diminished in accordance with the voice frequency.

Figure A gives a complete view of the radio-telephone transmitter which has been designed to operate on a wavelength of 75 centimeters. The two parallel wires (P and P1 in the diagram) are supported by the wooden pole and the oscillator tube V1 is mounted on the top. The sliding bridge and the bipolar antenna, (A-C) which are adjusted to tune the closed oscillatory circuit to resonance with the transmitted frequency, are provided with a telescoping brass rod. B is the buzzer which is used to modulate the system for telegraphy, and the telephone modulation equipment is located to the right. The designating letters of all parts correspond with those in the diagram (Fig. 3.)

The 120 storage cells located under the table are used for providing the grid potential to the oscillator tube.

THE RECEIVER

The apparatus used for receiving signals on wavelengths of 75 centimeters is shown in Fig. B. The construction of the receiver is very similar to the transmitter, although the circuit is somewhat different. The long wooden rod supports a crystal detector in an insulated tube (D) at the top, and the two parallel wires are carried up the sides of the rod. The bi-polar antenna (A and A1) and the sliding bridge are also mounted in much the same manner. The wires to the headphones go up the inside of the rod and the escape of R.F. currents is prevented by small choke coils (L.)

If, in place of the headphones, an extremely sensitive measuring instrument is connected to the detector circuit of the receiver, the transmission of short waves through space can be observed and investigated. Here we must refer to an observed phenomenon; if the waves from the transmitter or the receiver are thrown back or reflected by a metal plate, they will then interfere with the direct transmission and, in this way, there are produced "standing waves" which can be recognized by the rising or falling of a galvanometer needle. The apparatus is so sensitive that waves reflected at a distance of several meters can be observed.

The intensity of reception is at maximum when the transmitting and the receiving antennas are parallel. If one of them is turned through 90 degrees, the reception disappears completely, and then by further turning is brought again to maximum. Plotting the galvanometer changes with polar coordinates produces a graph for a bi-polar antenna similar to that shown in Fig. 4.

LATEST DESIGN

For reception over greater distances, we have to design an efficient vacuum-tube receiver. After various experiments the circuit shown in Fig. 5 was chosen, and this has given very good results. V is a vacuum tube, with a grid condenser (C) and a grid leak (R) of one megohm. The oscillatory circuit is formed just as it is in the transmitting circuit, with two parallel wires on which slides the bridge extending to the antenna. Now, as only the plate potential is carried over the parallel-wire system, the condenser portion of the bridge is superfluous. The tuning in of the signal from the transmitter must be accomplished by sliding the bridge and by lengthening or shortening the antenna. The tuning of the oscillatory circuit with these methods is extremely difficult and the highest sensitivity is finally obtained by variation of the plate potential.

Fig. C shows the receiver as it appears completed. As in the detector circuit previously described, the high-frequency section must be withdrawn as far as possible from the disturbing influence of the ground, and supported on the vertical insulating tube. The circuit constants with ultra-short waves are very small; so that the entire length of the system of parallel wires is only about 50 millimeters (two inches). The connections to the battery lead are brought down through the rear of the tube. To increase the amplification of the receiver, a Loewe triple tube (three sets of elements in one glass bulb, as described in RADIO NEWS for July, 1926) is connected in an audio amplifier circuit. With this apparatus, it is possible to demonstrate to a large number of listeners the phenomena of fixed waves, interference, reflection, etc., by means of a loud speaker. The experimenters have covered a distance of about 300 meters; but the intensity of the sound was still so great that the limit has been by no means reached.

The apparatus shown in the illustration at the right is designed to receive signals down to a wavelength as short as half a meter. The capacity of the tube is so high, in relation to this frequency, that only about TWO INCHES *of the parallel wires extending to the base of the tube is required in the tuned oscillatory circuit. The aerial lies across these at right angles, and moving it tunes the receiver—a very delicate operation. Three stages of audio amplification are combined in the single tube on the battery container.*

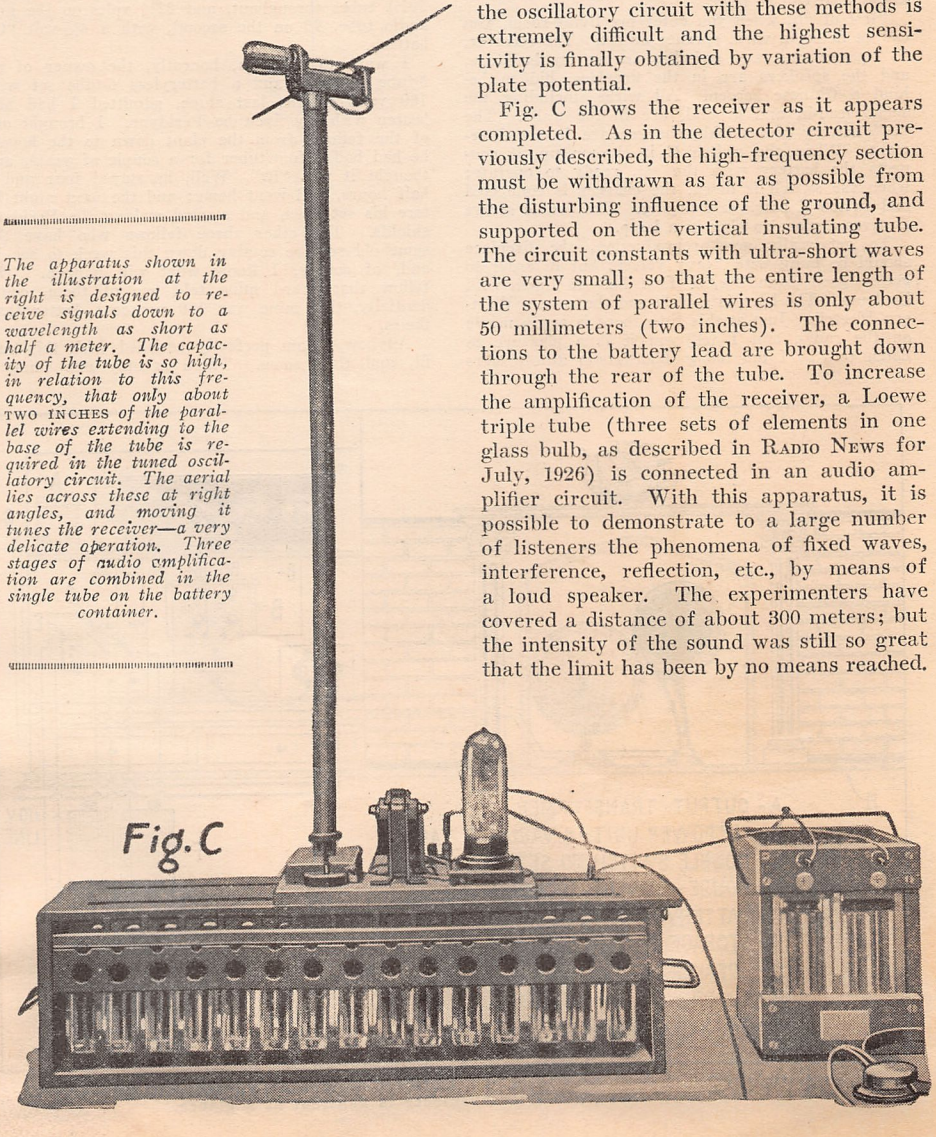


Fig. C

Letters from Home Radio Set Constructors

EARLY WORK IN RADIO

Editor, RADIO NEWS:

I read the Somersalo frequency-filter article with interest, because the first receiver I ever built had three stages of untuned R.F. amplification. After months of experiment, I was able to secure razor-edged selectivity with this receiver. It was used to give concerts in small towns in Louisiana and Arkansas, and was the first radio set seen and heard by thousands of people.

The signal was first selected by a single-tube regenerator, having a lamp-cord aerial about 20 feet long. This regenerator was in a separate cabinet and placed a few feet away from the other receiver and its loop. The regenerator had the regeneration control for all stations, hence operation was easy. The signal radiated by the regenerator was picked up by the loop. It was found advantageous to place a R.F. choke and "C" battery between the loop and the potentiometer lever, because the latter then had the same setting for all stations, and the selectivity was improved. The combination of receivers was operated as a two-dial tuned set, and it was not necessary to readjust either the regeneration control or potentiometer lever. It was necessary that the coupling between the regenerator and the loop should be very loose. An outdoor aerial was never needed.

C. J. ROGERS,
McAllen, Texas.

RADIO IN THE FIREPLACE

Editor, RADIO NEWS:

In your editorial, "What's What in Radio, you mentioned that two speakers will give the best music. Well, "you said it;" and if anyone wants to go to the trouble to do what I did, he will be well repaid. I have been using for over a year now the combination shown in the diagram; and many of my friends who have heard this outfit have asked me to write to you and let other fans know what can be done.

First of all, when you enter my living-room, you cannot detect a wire, speaker or set. The receiver, 'B" power unit and switches are in my bookcase, and the speakers are in the fireplace, hidden behind a Chinese screen. All wires, including the aerial lead-in and ground, are in the walls. The "A" battery and trickle charger are in the basement. When the switch C is thrown up, it connects the battery with the set, ready to operate; when the switch is down, the charger is connected and switch E starts it charging. The double socket D gives a place to plug in a lamp.

To get really good reproduction, the fireplace should be hung with heavy velvet; but in order to get a good soundbox, I first had it lined with linoleum. The horn is a Rola and the cone a Western Electric. Just at this time there is organ music on the radio, and I tell you it is a pleasure to listen to it. I am using Thordarson autoformers and two power tubes, with 200 volts "B"; this hook-up will bring a symphony concert to your home in proper style.

I am an old radio bug—since 1919—and distance does not mean anything to me; but on quality I'm a crank. I always enjoy reading your magazine, and I can boast of having all your copies. Should anyone wish any more information, I will gladly write to anyone.

J. LARDEMER,
355 Douglas Street, San Francisco, Calif.

(Our caution should be repeated; readers should not write for elementary radio information, or for instructions on points which should be apparent to anyone who has the mechanical or electrical skill necessary to build such an installation. The equipment pictured here is an excellent combination for those who have a suitable nook in which to install it. The speakers might well be tested in series and in parallel. In previous issues of this magazine full directions have been given for a connection which permits, with the aid of a suitable switch, all possible combinations of one or both.— EDITOR.)

MISSIONARY WORK

Editor, RADIO NEWS:

You are a friend to me for publishing the Peridyne Five. I have built three or four sets up to now, and when I read that article, I thought "This fellow is making a broad statement, but it reads good to me." I am using a four-tube regenerative set, and four other fellows at the same plant had the same kind, and they thought they had the last word in radio; all were bugs of five or six years' standing.

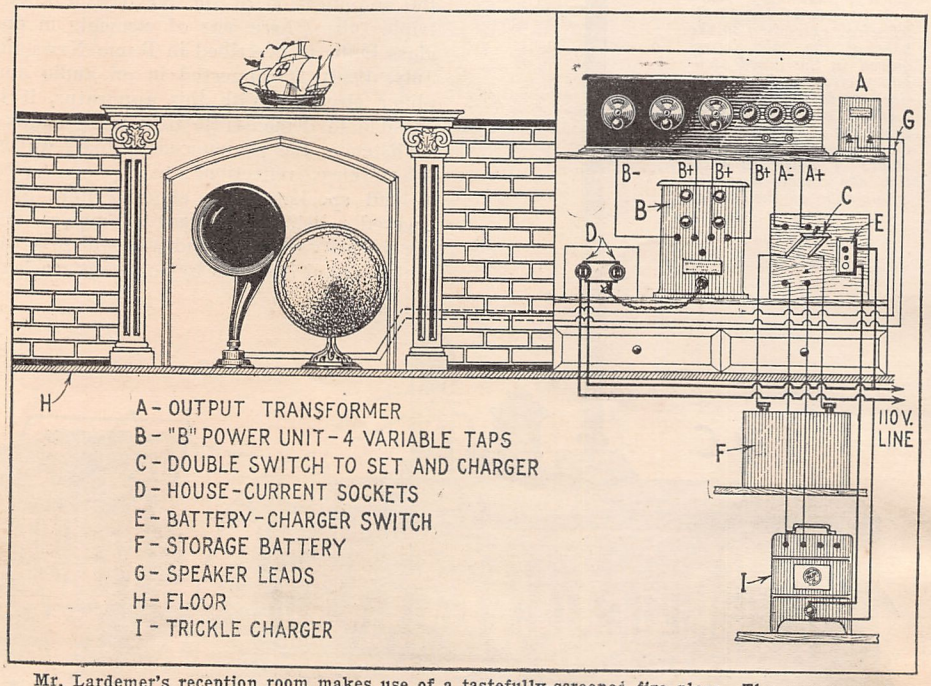
Well, my set has two .0005 geared condensers, so I bought one more and made all the coils, and cans of copper about .02-inch thick; and for about $10.00 completed the set out of the four-tuber I was using, with only two alterations from the published circuit (three condensers instead of a gang and a resistor of 10,000 to 700,000 ohms). I used 201A tubes throughout, and 22½ volts on the first audio tube, 90 on the second, with a 4½-volt "C" battery.

I want to tell you, honestly, the owner of an 8-tube superhet and a batteryless 6-tube set with 180 volts on the last stage, admitted I had him beaten with my five-tube Peridyne. I brought one of the fellows from the plant down to the house; he had had a four-tuber for a couple of years, and thought it was "it." Well, he stayed four and a half hours, and went home; and the next night he tore his set down and started making the Peridyne shields. The other three fellows who have the same old set are coming down this week to see it, and, of course, I know what will happen. The fellow that heard mine told one of them, confidentially, that mine was 100 per cent. better than theirs.

Anyhow, I am perfectly satisfied with this outfit, and then some. There is only one thing I want, and that is another aerial in the other direction; the one I have is east and west, and all sets should have aerials north, south, east and west. I have proved this by trying previous sets for months at a time, first on a street east and west, and then on a house whose street lay north and south. An aerial in one direction only is directional, like a loop or a superhet. You don't notice it, because you can't move it around; but put another aerial in the crosswise direction, and you will get stations you never had before on the same set.

I am going to write you again in the near future —don't forget I am 500 miles north of you, up in Canada. I have had the set working one week, and here are the stations I have logged. (*List of 51 stations in the United States and Canada, ranging to St. Petersburg, Fla., and Fort Worth, Tex.*) and a bunch more that I haven't had time to log. I will send you a full list later on. I might also state that I think those who buy RADIO NEWS buy all there is in radio literature. I have tried them all. Again allow me to thank you. Yours in appreciation,

JOSEPH ADAMSON,
14 Balsam Avenue, North, Hamilton, Ontario.



Mr. Lardemer's reception room makes use of a tastefully-screened fire place. The arrangement is shown above, and its convenience is apparent at a glance.

A SATISFIED SET BUILDER

Editor, RADIO NEWS:

I have noted, carefully, practically every circuit that you have published in your magazine for the past five years; but I am still using a five-tube neutrodyne which I constructed from Fada parts over three years ago, and I have found no other circuit any more satisfactory for my use here in the country, where I am located, sixteen miles west of Richmond on the James River.

Speaking of DX reception, I can nearly always get KFI on the loud speaker, and with good volume, at any time at night during their broadcasting hours, except when WRC at Washington is on the air. When Lindbergh was in Mexico City, I was prompted to tune in for the G.E. station there (CYJ) and experienced no difficulty in hearing the station clearly before 9 o'clock in the evening.

My success with my receiver is due principally to the fact that I am using regeneration in addition to the already excellent amplification of the neutrodyne circuit, which results in a real DX-getting set. The method of doing this successfully was first brought to my attention by a most interesting article by Mr. A. L. Graves, "The Regenerative Neutrodyne," published in RADIO NEWS in April, 1925. Instead of getting regeneration from a variometer in the detector circuit, I am using a winding which was inserted in the tube of the second R.F. transformer; regeneration being controlled by a variable condenser in series with this special winding. I can get all the regeneration desired with fine control throughout all the wavelengths from 200 to 575 meters. I am using five UV-201A R.C.A. tubes, and three of them have given over 3,200 hours' service and are still doing good work!

W. D. Moss, M.E.,
"Huguenot," R.F.D., Moseley, Va.

LETTERS for this page should be as short as possible, for so many are received that all cannot be printed. Unless a set is made from a published description, a schematic sketch should be sent; photos can be used only to illustrate a novelty, and then only if large and very clear. Inquiries for information not given here should be sent to the constructor direct; but he should NOT be asked to furnish data already published, here or elsewhere.

This department is for free discussion to the extent that space permits; but RADIO NEWS accepts no responsibility for the opinions of readers as to the relative merits of apparatus and circuits.

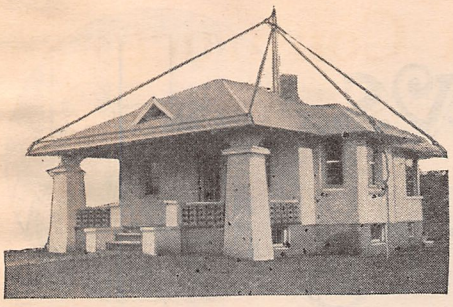
ECCENTRIC CONE WORKS WELL

Editor, RADIO NEWS:

The second prize wrinkle in your January issue interested me, as the possessor of one of the original Crosley Musicones. I tried out the eccentric cone idea and really believe Mr. Crosby should have been awarded first prize.

In making the new cone I used Fonotex paper and found that in the small cone for the apex I had to cut out seven-eighths, instead of five-eighths, to get a snug fit.

I made a light wooden frame mounting for the Crosley unit and, as the weight of the new cone hanging on the rather small actuating pin of the



Mr. Hurley's aerial, showing how great length is obtained in small space. His letter is on page 1191.

unit caused it to assume a position with the long diameter toward the bottom, I had to remount the unit and cone on a longer upright shaft.

The weight of the cone caused the short, or top part, to lean over against the top edge of the cover of the unit, and bent the actuating pin upward into a considerable curve. Believing from what I had read that the pin must always be perfectly straight, and perpendicular to the unit, I could see no reason why the contrivance I had built should be worth a cent as a loud speaker, or even speak at all.

However I hitched it up and turned on the set; result, the finest-toned speaker I have ever listened to, and I have heard the Radiola, Western Electric, Peerless and all the rest of them. The tone was unbelievably pure, true and natural, low notes just right in volume and absolutely no sounds that should not be there. I have more respect for the little Crosley unit than before.

Should have said that I built the 20-inch cone which, I believe, is plenty large enough for home use where quality alone is desired. Would like to try it again, but am afraid I would never again have such luck.

C. E. Currier,
1476 *Belmont St., N. W., Washington, D. C.*

AN OLD FAVORITE

Editor, Radio News:

Recently I constructed the Interflex Four, described in the September, 1925, issue of Radio News, and I find that it is the best four-tube set that I have ever seen or heard. The volume is good, it has remarkable tone quality, and it's fine for DX. The furthest station I have received is KFON at Long Beach, Calif., on the loud speaker. I advise anyone who wants a good set to build the Interflex Four.

It works very well with the simple "B" power unit described in the April, 1927, issue of Science and Invention. This unit works very well with a 201A tube, but I am using a 216B. All fans who want a good power unit that works as well as batteries should build it. Anyone wanting information on either can get it from me by sending a letter or card. Herbert L. Traylor, Jr.

(*We will do Mr. Traylor a favor by leaving out his address, because we know what will happen as a result of his generous offer, if we do not. To make his DX record clear, however, we may say that he is a resident of Virginia. The Interflex Four is an early design using the same principle which is exemplified, with improved components, in the Peridyne Five. Some constructors, however, cling to the earlier and simpler model, with which some remarkable results have been obtained.*— Editor.)

AN "SOS" COMES IN

Editor, Radio News:

HELP! Since the publication of my letter in the January issue of Radio News—which letter, by the way, I did not intend you to publish—referring to my success with the Radio News Short-Wave Receiver, I have been receiving communications in flocks requesting all sorts of information

(*Continued on page* 1191)

List of Broadcast Stations in the United States

(*Continued from page* 1121)

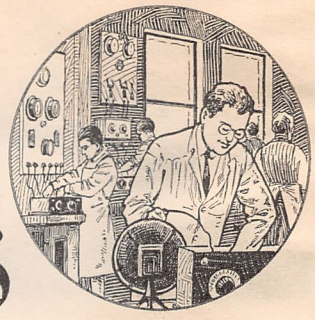
Radio Call Letter	BROADCAST STA. Location	Wave (Meters)	Power (Watts)
WJBU	Lewisburg, Pa.	214	100
WJBW	New Orleans, La	238	30
WJBY	Gadsden, Ala.	234	50
WJBZ	Chicago Heights, Ill.	208	100
WJJD	Mooseheart, Ill.	**366	1000
WJKS	Gary, Ind.	232	500
WJPW	Ashtabula, Ohio.	208	30
WJR-WCX	†Pontiac, Mich.	441	5000
	(Also 32 meters, 75 watts)		
WJZ	†New York, N. Y.	**454	30,000
	(3XL, 59.96 meters, 30 k.w.)		
WKAQ	San Juan, Porto Rico	322	500
WKAR	East Lansing, Mich.	278	*500
WKAV	Laconia, N. H.	224	59
WKBB	Joliet, Ill.	216	150
WKBC	Birmingham, Ala.	219	10
WKBE	Webster, Mass.	229	100
WKBF	Indianapolis, Ind.	252	250
WKBG	Chicago, Ill. (portable)	201	100
WKBH	La Crosse, Wis.	220	500
WKBI	Chicago, Ill.	216	50
WKBL	Monroe, Mich.	205	15
WKBN	Youngstown, Ohio.	214	50
WKBO	Jersey City, N. J.	219	500
WKBP	Battle Creek, Mich.	213	50
WKBQ	New York, N. Y.	219	500
WKBS	Galesburg, Ill.	217	100
WKBT	New Orleans, La.	252	50
WKBV	Brookvile, Ind.	217	100
WKBW	Amherst, N. Y.	217	5000
WKBZ	Ludington, Mich	200	15
WKDR	†Kenosha, Wis.	248	15
WKEN	Amherst, N. Y.	204	250
WKJC	Lancaster, Pa.	252	50
WKRC	Cincinnati, Ohio.	246	500
WKY	Oklahoma City, Okla	288	150
WLAC-WDAD	Nashville, Tenn.	225	1000
WLAP	Louisville, Ky.	268	*30
WLB	Minneapolis, Minn.	246	500
WLBC	Muncie, Ind.	210	50
WLBF	Kansas City, Mo.	210	50
WLBG	Petersburg, Va.	214	100
WLBH	Farmingdale, N. Y.	232	30
WLBI	East Wenona, Ill.	238	250
WLBL	†Stevens Point, Wisc.	333	*1000
WLBM	Cambridge, Mass.	231	50
WLBN	Chicago, Ill. (portable)	204	50
WLBO	Galesburg, Ill.	217	100
WLBQ	Atwood, Ill.	219	25
WLBR	Rockford, Ill.	248	15
WLBT	Crown Point, Ind.	248	50
WLBV	Mansfield, Ohio.	207	50
WLBW	Oil City, Pa.	294	500
WLBX	Long Island City, N. Y.	204	250
WLBY	Iron Mountain, Mich.	210	50
WLBZ	Dover-Foxcroft, Me.	208	250
WLCI	Ithaca, N. Y.	248	50
WLEX	Lexington, Mass.	216	50
WLIB	See WGN		
WLIT	Philadelphia, Pa.	405	500
WLOE	Chelsea, Mass.	211	100
WLS	†Chicago, Ill.	**345	5000
WLSI	See WDWF		
WLTH	Brooklyn, N. Y.	256	250
WLTS	Chicago, Ill.	484	100
WLW	†Cincinnati, Ohio.	428	5000
	(Also 52.02 meters, 250 watts)		
WLWL	†Kearney, N. J.	370	2000
WMAC	Cazenovia, N. Y.	225	500
WMAF	So. Dartmouth, Mass.	428	500
WMAK	†Martinsville, N. Y.	545	750
WMAL	Washington, D. C.	242	500
WMAN	Columbus, Ohio.	234	50
WMAQ	†Chicago, Ill.	**447	*2500
WMAY	St. Louis, Mo.	234	100
WMAZ	Macon, Ga.	270	500
WMBA	Newport, R. I. (port.)	204	100
WMBB	†Chicago, Ill.	252	5000
WMBC	Detroit, Mich.	244	100
WMBD	Peoria Heights, Ill.	205	250
WMBE	St. Paul, Minn.	208	10
WMBF	Miami Beach, Fla.	384	500
WMBG	Richmond, Va.	220	50
WMBH	Joplin, Mo.	204	100
WMBI	†Addison, Ill.	**263	5000
WMBJ	Monessen, Penna.	232	50
WMBL	Lakeland, Fla.	229	100
WMBM	Memphis, Tenn	210	10
WMBO	Auburn, N. Y.	220	100
WMBQ	Brooklyn, N. Y.	204	100
WMBR	Tampa, Fla.	252	100
WMBS	Lemoyne, Pa.	234	250
WMBW	Youngstown, Ohio.	214	50
WMC	Memphis, Tenn	517	500
WMCA	†New York, N. Y.	370	500
WMCO	Saginaw, Mich.	219	250
WMES	Boston, Mass.	211	50
WMPC	Lapeer, Mich.	234	30
WMRJ	Jamaica, N. Y.	207	10
WNAC-WBIS	Boston, Mass.	461	500
WNAD	Norman, Okla.	240	500
WNAL	Omaha, Neb.	258	250
	(Also 105 meters, 50 watts)		
WNAT	Philadelphia, Pa.	288	100
WNAX	Yankton, S. D. (day)	278	1000
WNBA	Forest Park, Ill.	208	200
WNBF	Endicott, N. Y.	207	50
WNBH	New Bedford, Mass.	248	250
WNBJ	Knoxville, Tenn.	207	50
WNBL	Bloomington, Ill.	200	15
WNBO	Washington, Pa.	211	15
WNBQ	Rochester, N. Y.	205	15
WNBR	Memphis, Tenn	229	100
WNBT	Elgin, Ill. (time sigs.)	35.5	500
WNBW	Carbondale, Pa.	200	5
WNBX	Springfield, Vt.	242	10
WNBZ	Saranac Lake, N. Y.	232.	10
WNJ	Newark, N. J.	268	250
	(Has short-wave transmitter)		
WNOX	Knoxville, Tenn.	265	1000
WNRC	Greensboro, N. C.	224	250
WNYC	New York, N. Y.	526	500
WOAI	San Antonio, Tex.	500	5000
WOAN	Lawrenceburg, Tenn.	240	500
WOAX	Trenton, N. J.	240	500
WOBR	Shelby, Ohio (portable)	204	10
WOBT	Union City, Tenn.	205	15
WOBU	Charleston, W. Va.	268	50
WOC	Davenport, Iowa	375	5000
WOCL	Jamestown, N. Y.	224	25
WODA	Paterson, N. J.	294	1000
WOI	Ames, Iowa.	265	*2500
WOK	†Chicago, Ill.	252	5000
WOKO	Beacon, N. Y.	216	500
WOKT	Rochester, N. Y.	210	500
WOMT	Manitowoc, Wis.	222	100
WOO	Philadelphia, Pa.	349	500
WOOD	†Grand Rapids, Mich.	261	500
WOQ	Kansas City, Mo.	341	*250
WOR	†Kearney, N. J.	422	5000
	(Also 65.4 meters, 50 watts)		
WORD	†Batavia, Ill.	252	5000
WOS	Jefferson City, Mo.	422	500
WOW	Omaha, Nebr.	508	1000
WOWO	Fort Wayne, Ind.	229	*2500
	(Also 22.8 meters, 1000 watts)		
WPAP	see WQAO		
WPCC	Chicago, Ill.	224	500
WPCH	†New York, N. Y.	326	500
WPEP	Waukegan, Ill.	216	250
WPG	Atlantic City, N. J.	273	5000
WPRC	Harrisburg, Pa.	210	100
WPSC	State College, Pa. (day)	300	500
WPSW	Philadelphia, Pa.	207	50
WPTF	Raleigh, N. C.	545	500
WPUB	New York, N. Y.	236	500
WQAM	Miami, Fla.	384	750
WQAN	Scranton, Pa.	231	250
WQAO-WPAP	†Cliffside, N. J.	395	500
WQBA	Tampa, Fla.	238	250
WQBC	Utica, Miss (day)	216	100
WQBJ	Clarksburg, W. Va.	240	65
WQJ	Chicago, Ill.	447	500
WRAF	Laporte, Ind.	208	100
WRAH	Providence, R. I.	200	250
	(Has short-wave transmitter)		
WRAK	Escanaba, Mich.	283	50
WRAM	Galesburg, Ill.	248	50
WRAW	Reading, Pa.	238	100
WRAX	Philadelphia, Pa.	213	250
WRBC	Valparaiso, Ind.	238	250
WRC	Washington, D. C.	**468	500
WRCO	Raleigh, N. C.	217	250
WREC	†Memphis, Tenn.	250	50
WREN	Lawrence, Kan.	254	750
WRES	Quincy, Mass.	217	50
WRHF	Washington, D.C. (day)	322	150
WRHM	†Minneapolis, Minn.	261	1000
WRK	Hamilton, Ont.	205	100
WRM	Urbana, Ill.	273	*500
WRMU	New York, N. Y. (port)	201	100
	(2XAO, ship, 105.9 meters, 100 watts)		
WRNY	†New York, N. Y.	326	500
	(Also 30.91 meters, 500 watts)		
WRPI	Terre Haute, Ind.	208	100
WRR	Dallas, Tex.	461	500
WRRS	Racine, Wis.	248	50
WRST	Bay Shore, N. Y.	211	250
WRUF,	Gainesville, Fla.	297	10
WRVA	Richmond, Va.	254	1000
WSAI	†Cincinnati, Ohio.	361	5000
WSAJ	Grove City, Pa.	224	250
WSAN	Allentown, Pa.	222	100
WSAR	Fall River, Mass.	213	250
WSAX	Chicago, Ill. (port)	204	100
WSAZ	Huntington, W. Va.	250	100
WSB	Atlanta, Ga.	476	1000
WSBC	Chicago, Ill.	232	500
WSBF	St. Louis, Mo.	441	250
WSBT	South Bend, Ind.	400	500
WSDA	see WARS.		
WSEA	Virginia Beach Va.	263	250
WSGH	Brooklyn, N. Y.	227	500
WSIX	Springfield, Tenn,	250	150
WSKC	Bay City, Mich.	273	250
WSM	Nashville, Tenn.	337	5000
WSMB	New Orleans, La.	297	750
WSMK	Dayton, Ohio.	297	200
WSPD	Toledo, Ohio.	240	250
WSRO	Middletown, Ohio	236	100
WSSH	Boston, Mass.	288	100
WSUI	Iowa City, Ia. (day)	476	500
WSUN	St. Petersburg, Fla.	517	750
WSVS	Buffalo, N. Y.	204	50
WSYR	Syracuse, N. Y.	225	500
WTAD	Quincy, Ill.	236	*250
WTAG	Worcester, Mass.	517	250
WTAM	Cleveland, Ohio	**400	*3500
WTAQ	Eau Claire, Wis.	254	500
WTAR-WPOR	Norfolk, Va.	236	500
WTAS	†Batavia, Ill.	275	500
WTAW	College Station, Tex.	484	500
WTAX	Streator, Ill.	248	50
WTAZ	Richmond, Va.	220	15
WTFF	Mt. Vernon Hills, Va.	203	10,000
WTFI	Toccoa, Ga.	210	250
WTHS	Atlanta, Ga.	227	200
WTIC	Hartford, Conn.	535	500
WTMJ	Milwaukee, Wis.	294	1000
WTRL	Midland Park, N. J.	207	15
WWAE	Chicago, Ill.	227	50¢
WWJ	Detroit, Mich.	353	1000
WWL	New Orleans, La.	246	500
WWNC	Asheville, N. C.	297	1000
WWRL	†Woodside, N. Y.	200	100
WWVA	Wheeling, W. Va.	517	250

*Allowed higher daylight power. **Standard or constant-frequency transmission. †Remote Control.

LIST OF CANADIAN BROADCAST CALLS

CFAC	Calgary, Alta.	435	500
CFCA	Toronto, Ont.	357	500
CFCF	Montreal, Que.	411	1650
CFCH	Iroquois Falls, Ont.	500	250
CFCN	Calgary, Alta.	435	1800
CFCQ	Vancouver, B. C.	411	10
CFCT	Victoria, B. C.	476	250
CFCY	Charlottetown, P.E.I.	312	100
CFGC	Brantford, Ont.	297	50
CFJC	Kamloops, B. C.	268	15
CFLC	Prescott, Ont.	297	50
CFMC	Kingston, Ont.	268	20
CFNB	Fredericton, N. B.	248	25
CFQC	Saskatoon, Sask.	330	500
CFRB	Toronto, Ont.	291	1000
CFRC	Kingston, Ont.	268	500
CFYC	Burnaby, B. C.	411	500
CHCA	Calgary, Alta.	435	250
CHCS	Hamilton, Ont.	341	10
CHCT	Red Deer, Alta.	357	1000
CHCY	Edmonton, Alta.	517	250
CHGS	Summerside, P. E. I.	268	25
CHIC	Toronto, Ont.	357	500
CHMA	Edmonton, Alta.	517	250
CHML	Mt. Hamilton, Ont.	341	50
CHNC	Toronto, Ont.	357	500
CHNS	Halifax, N. S.	322	100
CHPC	Vancouver, B. C.	411	1000
CHRC	Quebec, Que.	341	5
CHSC	Unity, Sask.	268	50
CHUC	Saskatoon, Sask.	330	500
CHWC	Regina, Sask.	312	15
CHWK	Chilliwack, B. C.	248	5
CHYC	Montreal, Que.	411	750
CJBC	Toronto, Ont.	291-357	500
CJBR	Regina, Sask.	312	500
CJCA	Edmonton, Alta.	517	500
CJCJ	Calgary Alta.	435	250
CJCR	Red Deer, Alta.	357	1000
CJGC	London, Ont.	330	500
CJGX	Yorkton, Sask.	476	500
CJOC	Lethbridge, Alta.	268	50
CJOR	Sea Island, B. C.	291	50
CJRM	Moose Jaw, Sask.	297	500
CJSC	Toronto, Ont.	357	500
CJWC	Saskatoon, Sask.	330	250
CJYC	Scarboro, Ont.	291	500
CKAC	Montreal, Que.	411	1200
CKCD	Vancouver, B. C.	411	1000
CKCI	Quebec, Que.	341	23
CKCK	Regina, Sask.	312	500
CKCL	Toronto, Ont.	357	500
CKCO	Ottawa, Ont.	435	100
CKCR	St. George Ont.	258	25
CKCV	Quebec Que.	341	50
CKCX	Toronto Ont.	291	500
CKFC	Vancouver, B. C.	411	50
CKGW	Bowmanville Ont.	312	5000
CKLC	Red Deer, Alta.	357	1000
CKMC	Cobalt, Ont.	248	5
CKNC	Toronto, Ont.	357	500
CKOC	Hamilton, Ont.	341	100
CKOW	Scarboro, Ont.	291	500
CKPC	Preston, Ont.	248	0
CKPR	Midland, Ont.	268	58
CKSH	St. Hyacinthe, Que.	312	50
CKSM	Toronto, Ont.	291	1000
CKUA	Edmonton, Alta.	517	500
CKWX	Vancouver, B. C.	411	50
CKY	Winnipeg, Man.	384	500
CNRA	Moncton, N. B.	322	500
CNRC	Calgary, Alta.	435	500
CNRE	Edmonton, Alta.	517	500
CNRM	Montreal, Que.	411	1650
CNRO	Ottawa, Ont.	435	500
CNRQ	Quebec, Que.	341	50
CNRR	Regina, Sask.	312	500
CNRS	Saskatoon, Sask.	330	500
CNRT	Toronto, Ont.	357	500
CNRV	Vancouver, B. C.	291	500
CNRW	Winnipeg, Man.	384	500

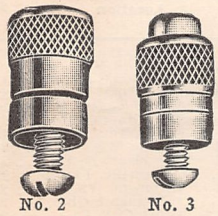
Radio News Laboratories



RADIO manufacturers are invited to send to RADIO NEWS LABORATORIES *samples of their products for test. It does not matter whether or not they advertise in* RADIO NEWS, *the* RADIO NEWS LABORATORIES *being an independent organization, with the improvement of radio apparatus as its aim. If, after being tested, the instruments submitted prove to be built according to modern radio engineering practice, they will each be awarded a certificate of merit; and that apparatus which embodies novel, as well as meritorious features in design and operation, will be described in this department, or in the "What New in Radio" department, as its news value and general interest for our readers shall deserve. If the apparatus does not pass the Laboratory tests, it will be returned to the manufacturer with suggestions for improvements. No "write-ups" sent by manufacturers are published in these pages, and only apparatus which has been tested in the Laboratories and found of good mechanical and electrical construction is given a certificate. As the service of the* RADIO NEWS LABORATORIES *is free to all manufacturers, whether they are advertisers or not, it is necessary that all goods to be tested be forwarded prepaid, otherwise they cannot be accepted. Apparatus ready for, or already on, the market will be tested for manufacturers free of charge. Apparatus in process of development will be tested at a charge of $2.00 per hour required to do the work. Address all communications and all parcels to* RADIO NEWS LABORATORIES, 230 *Fifth Avenue, New York City.*

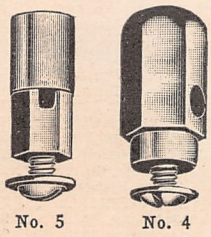
BINDING POSTS

Of the five shown here, No. 2 consists of two separate part: a round base and a knurled knob. Inside this knob slides a threaded cylindrical nut, into which fits the screw which attaches to the base of the panel. The nut is held in position by a short, but strong spring. To attach a lead to this binding post, the knob may be either completely unscrewed or simply pulled out with the fingers.



No. 2 No. 3

No. 3 is similar in construction to No. 2, from which it differs slightly in that the sliding threaded nut is somewhat longer and passes through the top of the knurled knob. To operate this binding post, the knob is held between the index and middle fingers while the thumb is pressed on the top of the sliding nut. No. 4 has a spring-operated hexagonal sleeve and is provided with two holes; one approximately 5/32-inch

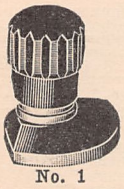


No. 5 No. 4

in diameter for ordinary leads, and a smaller one used exclusively for telephone tips. No. 5 is designed to be used only with telephone tips. These four types of binding posts are made of nickel-plated brass with a fine finish, and are very satisfactory in operation.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2263.

No. 1 resembles in construction No. 2, but has its knob molded in



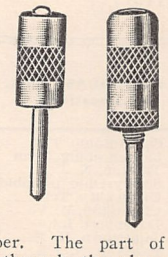
No. 1

bakelite. Its threaded base is likewise molded in a bakelite nameplate. This binding post is very neat in appearance and satisfactory in operation.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2264.

PHONE TIP

The phone tips shown are of the spring-operated type. Each consists of a sliding knurled sleeve and the

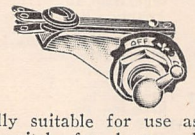


tip proper. The part of the tip passing through the sleeve is flat, and is provided at its end with a hole for the phone cord. This cord is tightened by the pressure of the sleeve, which is operated by a small spring device.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2265.

JACK SWITCH

The jack switch shown is of the single-pole double-throw type, and

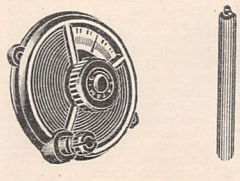


especially suitable for use as a selector switch for long and short aerials. It is compact and of excellent construction. The nickel-plated brass frame is insulated from the contact springs, which are made of phosphor bronze. These springs insure a perfect contact and are operated by a quarter-turn of a small metal knob of attractive design.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2269.

VERNIER DIAL

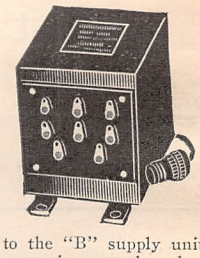
The tuning dial shown is of very fine mechanical workmanship. Its frame is 3½ inches in diameter and made of black molded bakelite. The dial proper is 3¼ inches in diameter and calibrated from 0 to 200, around its entire circumference. The indicator is of the hair-line type and has a vernier calibration which permits reading up to 1/10 of a division. This dial has two knobs; one in the center for rough adjustment, and a smaller one at the lower end of the dial for controlling the reduction gear, which has a very high ratio, namely 260:1. By pulling the little knob upwards, this may be disconnected, and the larger knob in the center can be used. A four-inch handle permits the operation of the reduction gear at a distance which prevents body-capacity, as far as possible. It is of German manufacture



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2270.

POWER TRANSFORMER

This power-unit transformer is designed to be used in "B" power-supply units, operating from the 110-volt 60-cycle house-lighting line, and using a half-wave rectifier tube of the UX-281 or UX-216B type. It has three secondary windings; one, which supplies 110 milliamperes at a maximum voltage of 750, is tapped at 550 volts for use with a rectifier of the 216B type. Another winding supplies 1.25 amperes at 7½ volts for heating the filament of the rectifier. A third, which is center-tapped, takes care of two power tubes of the UX-210 type with filament current of 2½ amperes at 7½ volts and makes possible the addition of a power am-

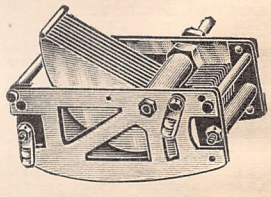


plifier to the "B" supply unit. This transformer is rugged and compact and is sealed in a heavy japanned iron shell.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2271.

CONDENSER

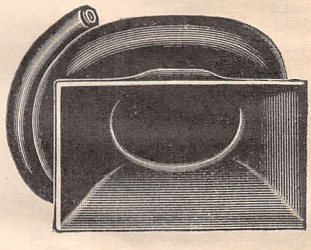
The variable condenser shown is of the one-hole-mounting low-loss type. The plates of the stator and rotor are of such shape that the straight-line characteristic of this condenser is of neither the frequency, capacity, nor wavelength type; but it is a combination of all three, being nevertheless very close to the S.L.F. variation rate. It is of good electrical and mechanical design; the make is German.



AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2272.

EXPONENTIAL HORNS

The larger loud-speaker horn



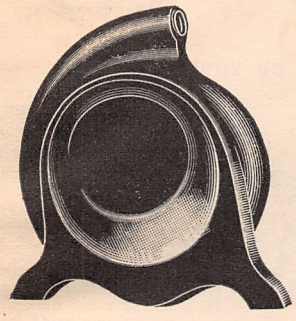
shown here has a coiled air chamber of the exponential type, is made of compressed wood-pulp and approximately 90 inches long; its rectangular bell is 18 x 24 inches. This horn has a low cut-off frequency, and affords brilliant reproduction when used with a good speaker unit. The depth of this assembly is approxi-

IN accordance with the new editorial policy which RADIO NEWS *has elsewhere announced, the names of the manufacturers or distributors of the apparatus and components described in this page will no longer be printed here. Readers who desire to know the names and addresses of the manufacturers of any articles described here, or whether any given type of radio material made by a certain manufacturer has been tested and certified as meritorious by the* RADIO NEWS LABORATORIES, *may obtain this information by sending a specific inquiry with a stamped and self-addressed envelope to the "I Want to Know" department of* RADIO NEWS, 230 *Fifth Avenue, New York City. Inquiries as to the comparative merit of two or more articles, which are both of approved quality, cannot be answered, even confidentially.*

mately 14 inches and its compactness adapts it for inclusion in any of a great number of radio cabinets.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2273.

This speaker horn, of the same make as that shown above, but much smaller, is also of the coiled type and made of compressed wood-pulp. Its air column is approximately but 30 inches long; nevertheless during

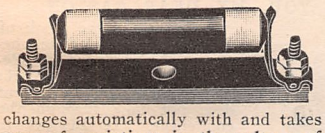


the tests, satisfactory reproduction of music and speech was obtained from it, in connection with a good loud-speaker unit, and it may be incorporated in radio receivers where relatively little space is available.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2274.

FILAMENT BALLAST

The resistor shown is intended for use in series with the filament of a screen-grid (type 222) vacuum tube when operated on a 6-volt storage battery. Its resistance

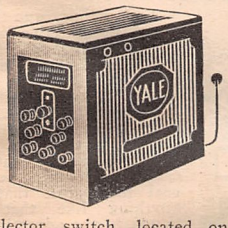


changes automatically with and takes care of variations in the voltage of the storage battery, and insures an approximately constant value of the current flow through the filament. It may be used with any vacuum tube of a type requiring 132 milliamperes at 3.3 volts and operating from a 6-volt storage battery.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2275.

"B" POWER UNIT

The "B" power unit shown operates from the 110-125-volt, 50-60-cycle house-lighting line, and uses an 85-milliampere full-wave tube as rectifier; five binding posts supply taps for the necessary voltages required to operate the average commercial radio receiver. The unit has a maximum output of approximately 50 milliamperes at 180 volts.

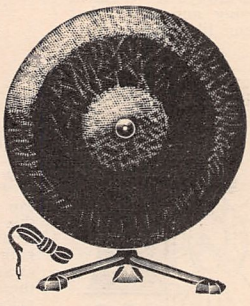


A selector switch, located on the output panel and operated by a plug, is provided to take care of the current demands of different radio receivers; it can be used also to compensate the different line voltages. Two extra binding posts on the panel are connected to an automatic double-pole relay switch built into the unit; this switch is operated by the filament current and controlled from the filament switch of the receiver. It requires approximately 600 milliamperes to operate and has a resistance of approximately 0.21 ohms. The entire unit is enclosed in a molded hard rubber case of attractive mahogany finish.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NOS. 2276-2277.

CONE SPEAKER

The loud speaker shown is of the double-cone type, and uses a 24-inch diaphragm of parchment-paper, having a beautiful leather finish. The unit is of the balanced-armature type, and of interesting construction. Its laminated "U"-shaped pole pieces, made of silicon steel, are cast into the aluminum frame. A heavy horseshoe permanent magnet, which has one side 5/8-inch longer than the other, is held in position with regard to the pole pieces by set screws in the aluminum frame; so that drilling the magnet is not required. The two coils, which are of elliptical section, are relatively large and are clamped into the pole pieces; two special holes in the frame allow easy mounting of this unit on the loud-speaker frame. The tone quali-

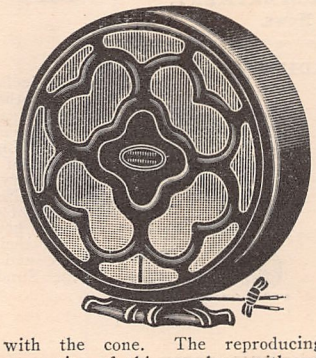


ties of this speaker are excellent; the reproduction has naturalness and great volume.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2278.

CONE SPEAKER

The speaker shown is a reproducer of the free-edge cone type, with a paper diaphragm 11 inches in diameter. It has a unit of floating-armature type, which is equipped with an adjusting screw. An iron housing of pleasing design, in brown crystalline finish, encases the unit

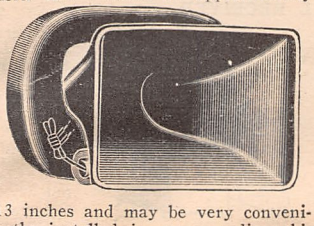


with the cone. The reproducing properties of this speaker, with regard both to quality and to volume, are very satisfactory.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2279.

EXPONENTIAL HORN

The loud-speaker horn shown is of the exponential type and made of impregnated fabric; the effective length of its air column is approximately 100 inches, and its bell section is 18 x 24 inches. This coiled horn has a depth of approximately

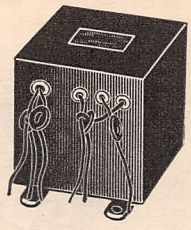


13 inches and may be very conveniently installed in many radio cabinets. The results, obtained when this horn was tested in connection with a powerful unit, were exceptionally good; particularly remarkable was the response to the lower musical notes.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2281.

POWER TRANSFORMER

The power transformer shown is intended for use in units supplying the required "A.B.C." power to radio receivers having in series up

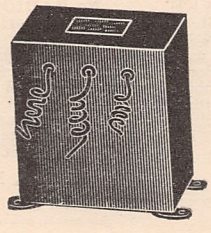


to eight tubes of the 201A type, and using in the last stage power tubes of the UX-171 or UX-112 type. It operates from the 110-volt, 50-60 cycle house line, and uses a 350-milliampere full-wave rectifier. Two center-tapped secondary windings supply 400 milliamperes at 300 volts on either side for the rectifier, and one ampere at 5 volts for the filaments of the power tubes. This transformer is of sturdy construction and is housed in a strong metal case having a black crystalline finish.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2282.

HEAVY DOUBLE CHOKE

The double choke shown may be used in the filter systems of power-supply units operating on 50-60-



cycle A.C., when the current does not exceed 400 milliamperes. The windings of the choke are connected to three outgoing leads. The ohmic resistance of each coil is, approximately, 106 ohms and its inductance, approximately, 10 henries. This double choke is sealed in a heavy sheet-iron container.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2283.

CONE SPEAKER

The double-cone loud speaker shown has a driving unit of the balanced-armature type. The reproducing cone is 20 inches in diameter and very handsomely decorated; the base of the speaker is of cast brass and has a very pleasing de-

sign. The performance of this instrument in reproduction of both music and speech has been found to be satisfactory.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2284.

HIGH-RESISTANCE POTENTIOMETER

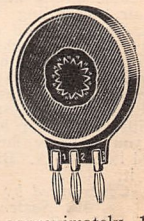
This instrument is a high-resistance potentiometer, using as a re-

sistance element a paper strip coated with graphite. The contact between the movable arm and the resistance strip is effected by means of a roller, which insures a smooth and a good contact and does not wear out the resistance element. This potentiometer is of the one-hole mounting type and has a very neat housing, made of nickel-plated brass, which contributes to perfect cooling.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2286.

ANTENNA COUPLER

The basket-weave coil shown is an antenna coupler of the auto-transformer type, with an inductance

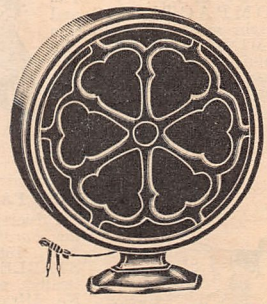


value of approximately 170 microhenries. It is enclosed in a casing of compressed cardboard with tips, connected to the corresponding ends of the coil. This device is of German manufacture.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2287.

LOUD SPEAKER

The cone speaker shown is of the free-edge type, and uses a unit of the balanced-armature type. The paper cone is 14 inches in diameter and is housed, together with the unit, in a beautiful metal casing, having a golden-brown crystalline finish. This instrument has been found a very good reproducer of music and speech.

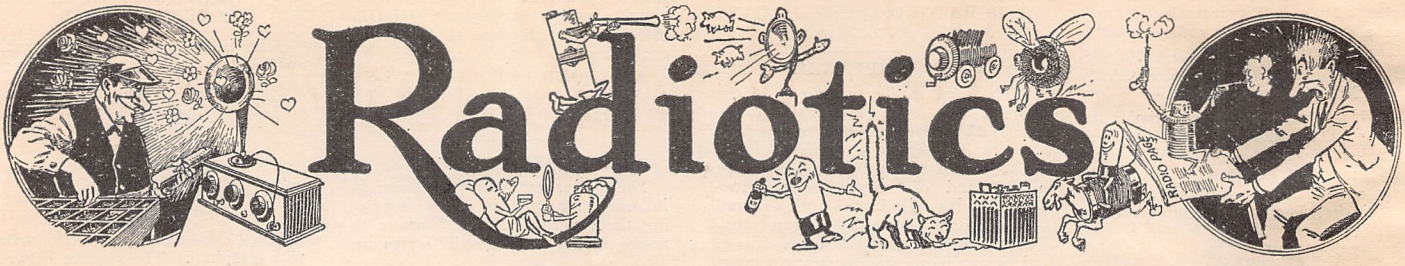


AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2288.

INTERFERENCE ELIMINATOR

The filter device shown eliminates completely, or reduces to a great extent, the radio interference due to motors up to five horse power, when inserted between the motor and the power line; it consists of two choke coils and two condensers of .05-mf. each. The two coils are inductively coupled and have a common core made of iron strips; the D.C. resistance of each coil is very low, approximately .037 ohms. Coils and condensers are housed in a heavy iron case, with several holes on its sides to permit good air circulation and insure effective cooling.

(*Continued on page* 1191)

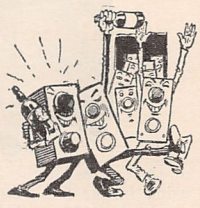


THE INTERPLANETARY RECEIVER

Astronomical note from the *New Haven Sunday Register* of Dec. 18: "Panel template for drilling METEOR holes, binding posts and variable resistances." If you have to wait until some night when meteors are falling thick and fast before you can get holes in your panel, we would advise, "Build some other set."

Contributed by H. Naftal.

YOU TELL 'EM!



In the *Lake County* (Illinois) *Register* of Jan. 11 we have this very frank description of a well-known manufacturer's sets: "The addition of the new plant will permit a larger manufacture of complete radio sets ly MAUDLIN AND SOMETIMES WORSE." We are always for truth in advertising and news; but this seems like an overdose.

Contributed by E. C. Dymond.

PEP UP YOUR BATTERY

A new method of removing battery oxide is mentioned in the *WCFL Radio Magazine*, (Vol. 1, No. 2): "The green oxide may be removed . . . by pouring warm WEATHER slowly over the surface of the battery." Mike of the Investigation Dept. is now on his way to Washington to get some warm weather from the Weather Bureau. He's having a hot time (?).

Contributed by R. J. Haase.

THAT BLASTING STUDIO

Station 1YA, Auckland, must put some strong stuff on the air, according to the *N. Z. Radio Record* of Dec. 23: "Mr. Fletcher insists on carrying on his radio work. 'I love it,' he says. So do his nephews and PIECES." If you see a man with an arm or leg missing you'll know he's been tuned in on 1YA. But they like it.

Contributed by W. Satterly (New Zealand)

PAGE MR. WEBSTER

In Crosley's advertisement in *Radio News*, February, 1928, a new adjective is discovered that smacks strongly of Elinor Glynn: "The new type D Musicone is a SEXTRAORDINARY as its companions and promises great satisfaction. . . ." At last a loud speaker with sex appeal! Boys, remember the female of the species is more deadly. . . .

Contributed by L. W. Battin.

WHAT PRICE EUGENICS?

Commenting on a new type of antenna, the *Radio World* of Dec. 31 says it is "so simple a $4 child can put it up." With all this eugenics and companionate-marriage stuff stirring up the country, you can't be sure of anything these days. $4 is a low price for a healthy child; but the trouble isn't the initial cost—it's the upkeep.

Contributed by R. Calvacchi.

LADY LUCK, THEIR PATRONESS

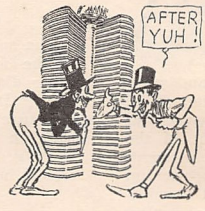
Interesting item from the *Cincinnati Enquirer* of Jan. 8: "For some time KWKH has been styling itself as 'the SUPERSTITION of the South.'" We were well aware that the South is the land of the rabbit's foot, horseshoe, conjures and other things smacking of the supernatural; but this is a new one on us. Where's it worn!

Contributed by Roy J. Sawyer.

IF you happen to see any humorous misprints in the press we shall be glad to have you clip them out and send to us. No RADIOTIC will be accepted unless the printed original giving the name of the newspaper or magazine is submitted, with date and page on which it appeared. We will pay $1.00 for each RADIOTIC accepted and printed here. A few humorous lines from each correspondent should accompany each RADIOTIC. The most humorous ones will be printed. Address all RADIOTICS to

Editor, RADIOTIC DEPARTMENT, c/o Radio News.

AFTER YOU, MY DEAR GASTON

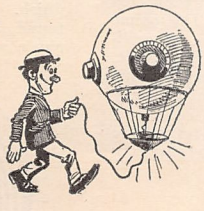


Influence of the Book of Etiquette upon electric phenomena related in the *Radio World* of January 21: "The alternating current does not flow through the condenser. It BOWS in and out of the condenser." We should, indeed, be able to extract the height of harmony from radio sets operated by so considerate a medium.

Contributed by W. S. Rosenik.

PRODIGIOUS PORTABILITY

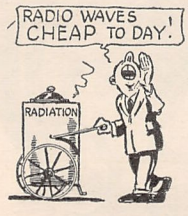
Exacting requirements for the set constructor in a prize competition sponsored by the *South African Wireless Weekly*, of Dec. 14: "The COMPACTNESS and weight must be reduced to a MINIMUM." Much ingenuity was required by these terms; but the problem has at last been solved by a gas-filled cabinet.



Contributed by Edwin Potter. (So. Africa)

IS THIS FADING?

Why you lost that station the other night is revealed in the *Chelsea, Mass. Record* of Dec. 30: "It is alleged by the police that the boys stole 643 pounds of RADIATION, valued at $20 from Philip Lewis' junk shop." Our guess is that the junk man collects worn out radio waves and peddles them to stations dissatisfied with their wavelength allocations.



Contributed by Don Emery.

FOOD FOR THOUGHT

Television is with us, and also other things reported in the *News Sentinel*, of Fort Wayne, Ind., on Jan. 14: "Light BEANS Take Pace of Sound Wave in Ordinary Radio." Soon in old New England, in the heart of the Bean Belt, the good housewives will discard their ovens on Saturday and use radio to get the Sunday breakfast.

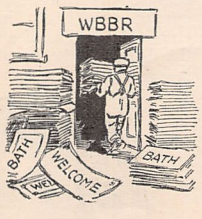
Contributed by D. R. Baker.

HELP FOR THE FARMERS

Advertisement found in the *Toronto Daily Star* of Jan. 16th: "RADIO STABLE and tubes, practically new, real snap." No, Mirandy, I ain't agoin' to get outa bed this cold mornin'. Let that goldurned radio feed the stock. Waddya think I paid that agent all that money for, if I have to get up and do the chores? No, siree.

Contributed by H. Garlick.

DUCK, MEN, HERE THEY COME



In the *Chicago American* of Dec. 24 we see this interesting piece of information: "These stations will try out 200-meter broadcasting next week: WORD using 5000 watts and WBBR 1000 MATTS." There is no doubt in our mind that WBBR would cover quite a stretch if these matts were rubber. We'll quit.

Contributed by Owen McArdle.

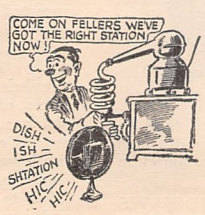
EXPENSIVE FUEL

A burning question is found in an advertisement in the *Portland Oregon Daily Journal* of Jan. 20: "$950 brand new 8-tube Radiola and Brunswick Panatrope COMBUSTION . . ." Mike of the I. D. informs us that coal is still rather expensive but, honestly, we would rather burn coal than stuff that costs anything like that mentioned in the advertisement.

Contributed by J. L. S. Snead.

HAIL, HAIL, THE GANG'S ALL HERE!

Volsteadian motif in receiver design, mentioned in the *Radio World* of Dec. 3: "A friction drive RUM is employed. . . ." this in connection with a gang condenser. We wish the manufacturers of sets to understand that this bootleg stuff can NOT be trusted. We want the varnish left on our set, so we'll stick to the old dials.



Contributed by Wm. Wiebe.

FOR THE RURAL RECEIVER

Pastoral gesture from the *Chicago Evening Post* of Jan. 5: "A quarter-inch GRASS shaft is provided so that the condenser may be used as any ordinary variable condenser." When your set doesn't tune in a station so very well, you might look inside and see if someone thoughtlessly used grain or alfalfa, thereby clogging up the works.

Contributed by Ronald A. McNeill.

TWENTY-FOUR VOTES FOR—

Forerunner of the coming political campaign mentioned in the *Radio World* of Dec. 31: "IRE Convention Here Soon." We have finally persuaded Mike of the Investigation Dept. to run for Generalissimo of Broadcasting. Among his other jobs will be to find out why tenors live. They're the ones that are stirring up all the ire.

Contributed by L. Geiser.

Conducted by C. W. Palmer

THIS Department is conducted for the benefit of our Radio Experimenters. We shall be glad to answer here questions for the benefit of all, but we can publish only such matter as is of sufficient interest to all.

1. This Department cannot answer more than three questions for each correspondent. Please make these questions brief; if the inquiry is concerning a circuit other than a standard, published one, delay will be prevented by enclosing a diagram and other necessary information.

2. Only one side of the sheet should be written upon; all matter should be typewritten or else written in ink. No attention paid to penciled matter.

3. Sketches, diagrams, etc., must be on separate sheets. This Department does not answer questions by mail free of charge.

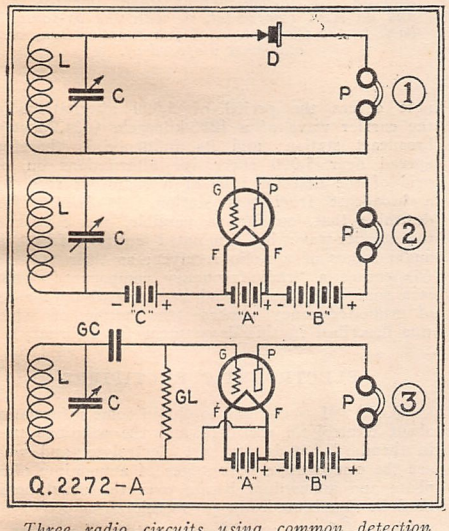
4. Our Editors will be glad to answer any letter, at the rate of 25c. for each question. If, however, questions entail considerable research work, intricate calculations, patent research, etc., a special charge will be made. Before we answer such questions, correspondents will be informed as to the price charge.

WHAT IS DETECTION?

(2272) Mr. R. J. Wentworth, of St. Louis, Mo., writes:

(Q.) "Will you explain how crystals and vacuum tubes operate, when used for 'detecting' radio signals?"

A. The crystal detector, which was very popular several years ago, and is still used in a very large number, if not a majority, of the radio



Three radio circuits using common detection methods: 1, crystal; 2, plate-current or "bottom-bend" rectification, with negative grid bias; 3, grid rectification with positive bias regulated by grid leak and condenser.

receivers outside of the United States, has the peculiar property of offering a higher resistance to electric currents passing through it one way than it does to those passing in the opposite direction. The radio-frequency alternating current, which we call the *signal*, comes from the aerial (or possibly through an R.F. amplifier) and tries to pass through the crystal, first in one direction, and then in the other; but its flow is practically confined to one way, because of the increased resistance offered to the current whenever it is reversed. Thus, only one-half of the incoming current passes through the headphones in the simple crystal-detector circuit shown by the diagram in Fig. 2272A at (1).

When we use the well-known three-element vacuum tube as a detector, we have our choice of two methods of detecting or "rectifying" radio signals; they are called *"plate rectification"* and *"grid rectification."* While the first is more easy to explain diagrammatically, the second is more commonly used. In addition to its detecting effect, the tube introduces also the action of "amplification." A rather simple analogy may serve to convey the idea, though not with complete details, in a form easier to comprehend.

We may compare the radio signal to waves caused by agitating water; these will travel a considerable distance, and by this means we might, for instance, send a message. Disregarding the complexities which are presented by the very intricate sounds of music and speech, let us concentrate on the idea of sending a succession of impulses, in the form of waves, which are comparable to the dots-and-dashes which puzzle, and occasionally annoy, the ordinary radio fan.

A Hydraulic Comparison

If we dip out and pour back a bucketful or so at more or less regular intervals from and into the body of water which is to be our medium of communication, we will set up waves; that is to say, we cause the water to rise and fall in rapid succession, for a considerable distance from our scene of operation. This is not a forward motion of the water, for the bucketful we pour in stays near us for a considerable length of time; it is a backward-and-forward, up-and-down motion, corresponding somewhat to that curve representing "voltage" changes that we picture when we talk of a "radio wave." We can put a small float on the surface of the water, at the point where we wish to receive the message carried on these waves; or let us make a little dam with its top at the exact water level, as shown in Fig. Q. 2272B at (1) and (2). When the "trough" of a wave comes along, no water will spill over; but when the "crest" arrives, it will break over the top of our little dam. This action we may compare to that of our crystal detector, which responds to the radio wave by passing only the half of it which is "above the line;" that is, the impulse in one direction only.

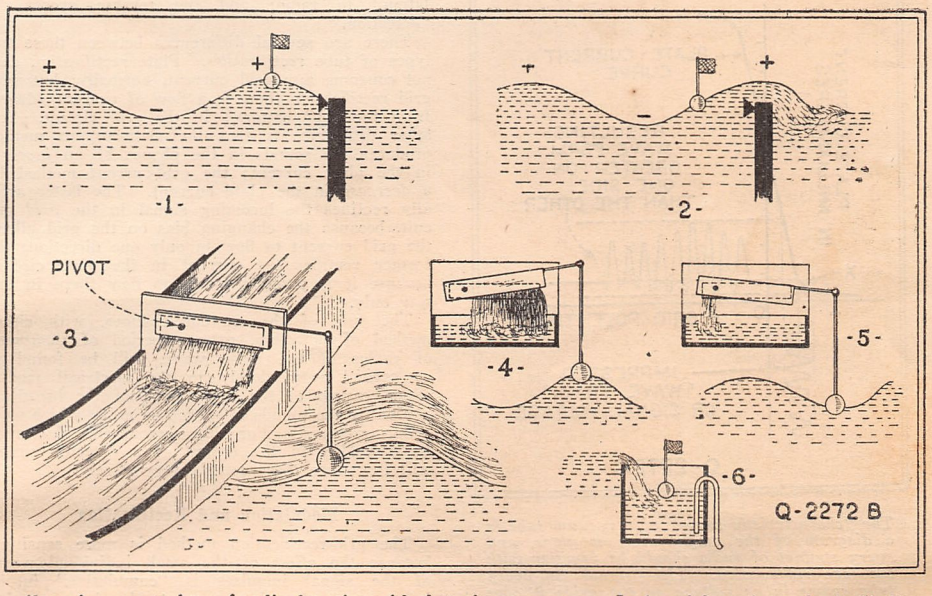
But we desire to get something more than the very feeble little wave which we thus receive; we want to put in motion in one channel a much larger amount of water. Here is where the "amplifying" action comes in. A radio tube is truly a "valve," as they call it in Europe; a small voltage applied to its grid, under certain conditions, *turns on and off the current from the "B" battery,* which is much greater in its electrical effect.

To illustrate the action of a tube, we have what is known as its "characteristic curve." Without explaining too technically the action it represents (see the department, "The Radio Beginner," in this issue) this curve indicates the amount of "plate current" which the tube passes, for any given amount of voltage difference between its filament and the grid and with a fixed value of plate voltage. The plate current is proportioned to the *height* of any given point on the curve just above the point on the scale indicating the corresponding grid voltage. At the bottom we have shown the effect of a typical "train" of radio waves on the grid voltage, and in the horizontal curve the corresponding "wave" in the plate circuit of current which can be used to actuate the diaphragm of a telephone (See Fig. Q. 2272 C.)

Returning to our water analogy, the simple rectifier, such as the crystal, cannot put into the telephones any more energy than it receives—less in fact, as current is used up in overcoming its resistance. Just so our little dam in Fig. Q. 2272B (2) must surround a depression kept lower than the water level, so that the incoming wave can spill into it.

The Hydraulic Amplifier

But we can use the rise and fall of a float on the waves to operate a gate and control the



Above is a comparison of radio detection with that of water waves. In 1 and 2 we have simple "half-wave" rectification; only the top half of the wave spills over the dam. In 3, 4 and 5, the float represents the tube grid, and the water in the aqueduct the plate current. In 6 the tank represents the grid condenser; it discharges through the "siphon" (the grid "leak") when the pressure becomes high enough.

flow of water from a higher level to a lower, as in Fig Q.2272B (3). Above our float we have an aqueduct containing a "weir," or water outlet, and a "sluice gate" regulating the flow of water. This gate, when it is perfectly level, permits a very slight amount of water to escape. It is pivoted far over to one side, so that tilting it one way permits a great deal of water to escape; while tilting it the other way practically cuts off the flow. We connect one end of this sluice to our little float.

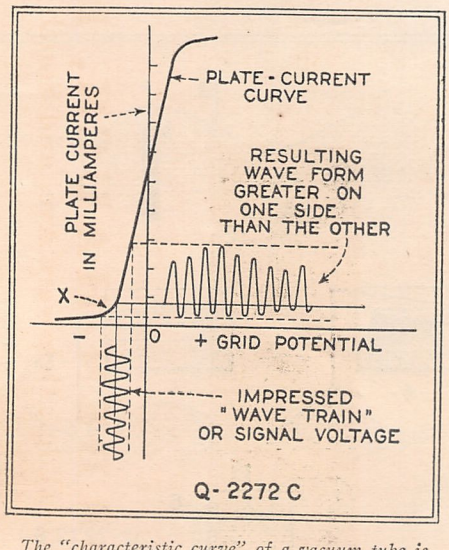
When the float rises, as pictured at (4), a great deal of water escapes; when it falls (5), the flow is practically cut off. The result is that, as the waves come in and lift our float, they increase and decrease the flow of water, at a much higher level and to a much greater amount; but that flow is steady and in one direction, not the backward-and-forward motion of waves. This is also the difference between the radio wave and the direct-current impulse which operates our telephone diaphragm.

Plate-Current Rectification

Returning to the electrical action, Fig. Q.2272C shows the *plate-rectification* effect which corresponds to the apparatus we have just described. It depends on the "bend" which we see at the bottom of the "characteristic curve" of our tube, and which corresponds to a limiting range of negative grid voltages, varying with the type of tube. In order to keep the grid at this negative voltage, compared with the filament, it is necessary to use a "C" battery or voltage-supply source with its positive terminal connected to the "A—:" for the "A—" voltage alone is not far enough below that of all points on the filament. Such a "C" battery is usually composed of several dry cells in series; or the "voltage drop" between the ends of a resistor in a power unit may be used for the purpose. (Fig. Q2272A at 2.)

At the bottom of the diagram, below the bend in the characteristic curve, we have pointed out the "voltage wave form" of the incoming radio wave. If we draw a line directly upward from any point on this curve, representing the *voltage on the grid at that instant* (the grid negative voltage or bias," *plus or minus* the voltage of the received signal, according as the incoming wave is at a positive or a negative stage) until it meets the characteristic curve, and then extend another line horizontally to the upright scale marked "plate current," we will get *the value of the current flowing between filament and plate at that instant.* If, for each value of the grid voltage, we find the corresponding value of the plate current, we can draw *the resulting wave form of the plate current—which is all direct current.* It will be seen that there is present some "distortion" of the wave form; that is, the variations in current are greater in one direction than in the other, when compared with the variations in voltage. In the diagram this result has been exaggerated to make it evident.

It is plain that we have in this case, not a true rectifying action, as with the crystal—but a relay or *amplifying* action. It will also be noticed that, with this method, no current flows in the grid circuit—unless the grid is allowed to become positive—and there is no drain on the "C" battery.



The "characteristic curve" of a vacuum tube is a diagram of the amplification it gives, and every student of radio should be familiar with the idea represented. The "signal" in every tube comes in as voltage on the grid; it goes out as current through the plate circuit. A "characteristic curve," drawn for a given tube, at a given plate voltage, shows what response may be expected from it for any given grid bias.

This is in contrast to the other method of detection, which is that used in most radio receivers, and which we will now describe.

Grid Rectification

When we refer again to Fig. Q.2272A, at (3), we find that the grid return has been changed from the "A—" to the "A+" filament lead, and that, in place of the "C" battery, we have a "grid leak" and a "grid condenser" in the grid-filament circuit. This places on the grid a positive bias of half the value of the voltage across the filament (when the grid is compared with the middle point of the filament); this is usually sufficient, without requiring an external application of positive voltage.

The action when this method is used is as follows: the incoming signal voltage tends to send a current through the circuit, from the grid to the filament, and back again. But this current can flow in only one way, *from the grid to the filament;* because of that property of the vacuum tube which permits electrons to travel only from a hot element (the filament) to a cold one (the grid or the plate). This current flow builds up an electric charge on the grid condenser, and causes the voltage on the plate of the condenser which is nearest the grid to become negative, as well as the grid itself.

Whenever the radio wave reverses, it merely stops the flow of electrons; for the space between the filament and the grid will pass a current in only one way. Thus the flow from the filament keeps increasing the negative charges on the grid until they oppose the incoming signal voltage and overcome it. The grid leak then allows the charge to leak off through the grid return to the filament. This cycle is repeated with each train of waves, the grid being in the same condition at the end as at the beginning. The resistance of the grid leak must be of a suitable value, to secure smooth operation, however.

This variation of the voltage on the grid, caused by the incoming signal, will also produce a variation in the plate current; as the grid becomes more negative, it decreases the flow of current from the "B" battery or power unit; and, as it becomes positive again, the flow of plate current becomes normal.

It will be, perhaps, more difficult to explain the difference between these two methods of tube detection by our hydraulic-gate analogy, to the satisfaction of our readers. They would correspond most closely to a readjustment of our wave-operated float, and of the point of pivoting in the sluice-gate which it opens and closes. In one method, we may say, the *rise* of the float closes the opening; in the other, the *fall* of the float closes the gate. Also, let us suppose that, to correspond with the grid-rectification process, the float is in a compartment into which successive waves spill, each raising the float a little more, until the water rises above an overflow level and discharges through a *siphon* (6).

In comparing this system to radio waves, we must suppose that these waves are created in series or "trains" by the millions, in regular succession with varying intervals and heights; and it is our desire to gauge, not the height of single waves, but the respective rapidity of the changes which are made in the rate of their production and the height of their crests. This corresponds to "modulation" in radio; and the reverse process is "detection."

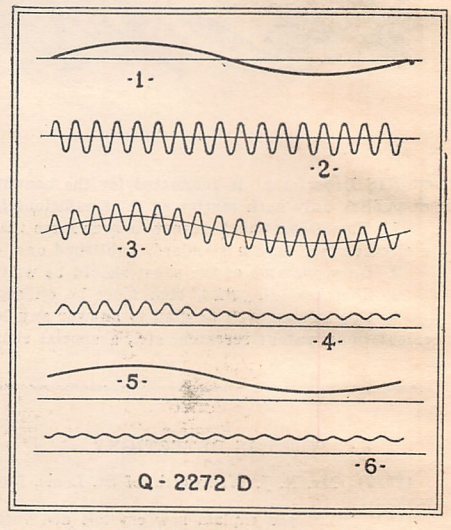
There are several differences between these two types of tube rectification. Plate rectification does not consume any grid current, normally; but with grid rectification there is a flow of current (drawn from the "A" battery) in the grid circuit. Another difference is that the plate-current method produces the sounds in the phones by an *increase* in the plate current; the grid-current method by a *decrease* in the plate current. The latter actually rectifies the incoming signal in the *grid* circuit, because the changing bias on the grid allows the grid current to flow in only one direction; the former rectifies the current in the *plate* circuit, because it is possible for it to flow there in one way only.

The sum of the current changes, with either method of detection, over a period of thousands of cycles of the radio wave, will be found to correspond very closely to the electrical modification caused at the microphone of the broadcast station by the sounds of speech or music which were being broadcast. For this reason, the phones or loud speaker in the output of a detector circuit will reproduce these sounds very closely.

Modulation and Rectification

The grid-rectification method is more sensitive, because the effect of the small individual waves of the signal impulses is "cumulative" in its influence on the plate current, thereby producing much greater voltage changes on the plate than does the plate-rectification method. See Fig. 2272D.

Each audible note reproduced in radio is converted into electrical alternations (1) at rates varying from about 30 to 5,000 per second; and then allowed to *modulate* more powerful alternations (2), made at a rate of from 550,000 to 1,500,000 per second, in the case of ordinary broadcast stations. In the case of short-wave stations, the carrier-frequency alternations may be at the rate of 20,000,000 a second. It is evident that each vibration of a 256-per-second (256 cycles equals "Middle C" on the piano) audio-frequency



In the illustration above, 1 and 2 represent the broadcast A.F. modulating wave and the station carrier wave, which are combined by "modulation" to form the alternating signal wave shown at 3. At 4 we have the result of detection, a somewhat distorted, pulsating direct current; this is separated by suitable means into an A.F. direct-current signal impulse, 5, and an R.F. component, 6, which is by-passed back to the filament, used for regeneration, or otherwise disposed of.

note covers the period of 5,000 alternations of the carrier wave of a 1280-kilocycle (234.2-meter) broadcast station; and its influence is therefore spread over 5,000 successive alternations on the grid of the detector tube of a radio set receiving a broadcast from this station. It is therefore desirable that, so far as possible, the effects of the carrier-wave be eliminated entirely from the audio stages of a radio receiver; as their presence (6) causes a "radio-frequency component," which is a source of trouble, and is combated by the use of radio-frequency chokes (the action of which was described in this department for February).

ELECTROLYTIC RECTIFIERS

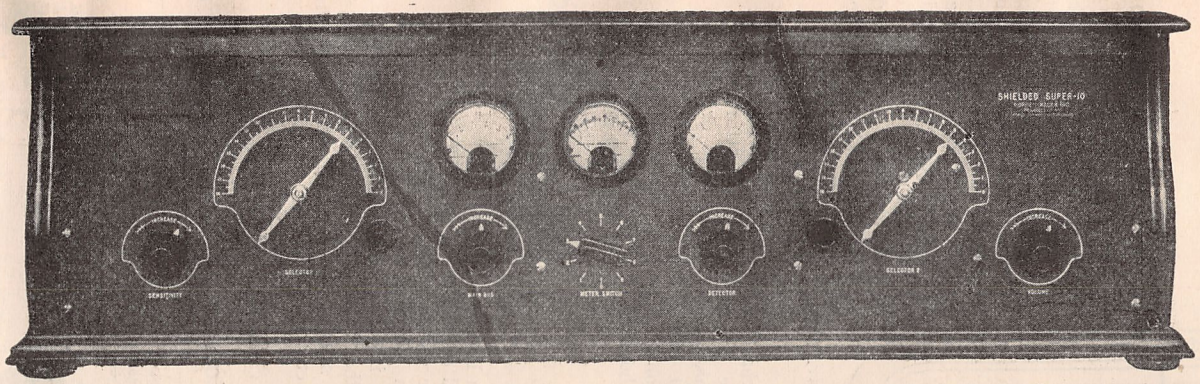
(Q. 2.) "I would like to obtain some information about electrolytic rectifiers and the solutions used in them. What is the best electrolyte, and what are the comparative advantages of ammonium phosphate and ammonium borate over the usual borax used in aluminum-lead-type rectifiers?"

(A. 2.) In the usual home-constructed rectifier, a saturated solution of commercial borax ("sodium biborate") is employed. This electrolyte is suitable in most cases; but if the borax is not entirely pure considerable trouble may be encountered. Ammonium phosphate or ammonium borate dissolved in distilled water is much more suitable. The former is prepared by dissolving as much "primary" or acid ammonium phosphate as the water will take up, thus making a saturated solution. Crystals should be added until they fall to the bottom, and then the liquid should be filtered off and used. A similar procedure may be followed with the borate; care should be taken to procure a chemically-pure "salt."

The ammonium-phosphate electrolyte may be allowed to stand idle for a long period of time without injury. The ammonium-borate electrolyte, during an idle period, will increase its internal resistance, which causes the voltage to drop off considerably. In some cases, it is necessary even to scrape the electrodes to make the rectifier function. The ammonium-borate solution reacts upon the lead plate; thus forming "lead peroxide," which gradually falls to the bottom of the container. No such trouble is encountered with ammonium phosphate. The aluminum electrode should be of the purest metal obtainable; since any slight impurity will cause a "local action" which will ruin the rectifier. It is advisable to place a rubber tube over the aluminum plate at the point where it leaves the solution, so that oxidization cannot take place at this point.

(*Continued on page* 1191)

FIVE TYPE UX222 SCREEN GRID TUBES ARE USED IN THIS ULTRA-POWERFUL BROADCAST RECEIVER, INCREASING the RADIO FREQUENCY AMPLIFICATION and SENSITIVITY OVER 500 TIMES



Front Panel View
NEW ADMIRALTY MODEL
with complete set of indicating meters. Panel size 9 x 36 x ¼ inches. Weight 45 lbs.

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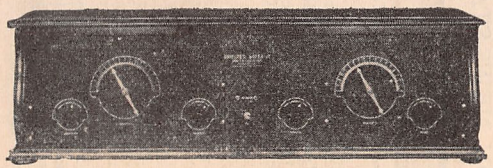

Standard Shielded Super-10—Front Panel view. This model is identical with the Admiralty model except for the indicating meters. However, it is equipped for the Weston Pin-jack Voltmeter.

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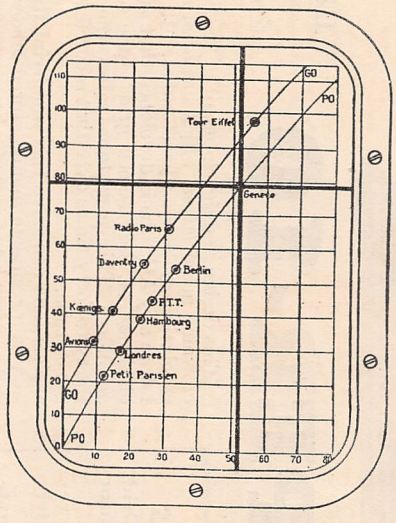
A Novel Radio Dial

TUNING devices have assumed many odd shapes; but there is a great deal of ingenuity in the indicator now used on a French make of receiver. The pointer of one tuning condenser moves horizontally, and the other vertically, across a scale; and their intersection shows the position of the station tuned in. It will be noticed that



Tuning scale of a new French receiver, for two wavelength bands.

there are two curves across the chart of wavelengths. One represents the lower range of European broadcast stations, practically equivalent to our broadcast band; and the other the long-wave stations, between a thousand and three thousand meters.

The Voice of Wales

WELSH members of the English Parliament have united in a demand on the British postmaster-general for the establishment of a broadcast station in Wales devoted exclusively to programs in the Welsh language. It is represented that this would be a great stimulus to the sale of radio sets in Wales, as well as of cultural value.

Airplane SOS Saves Ships

THE "SOS" has more than once of late called shipping to the assistance of aviators; the compliment was returned in the English Channel not long ago, when the pilot of a London-Paris aerial express observed that a small steamer below him was on fire. He at once used his transmitter to notify Croydon, England, which broadcast the alarm. It was picked up at Boulogne, France, from which port a tug at once put out, rendered timely aid, and towed the distressed vessel with her crew of fifteen safely into port.

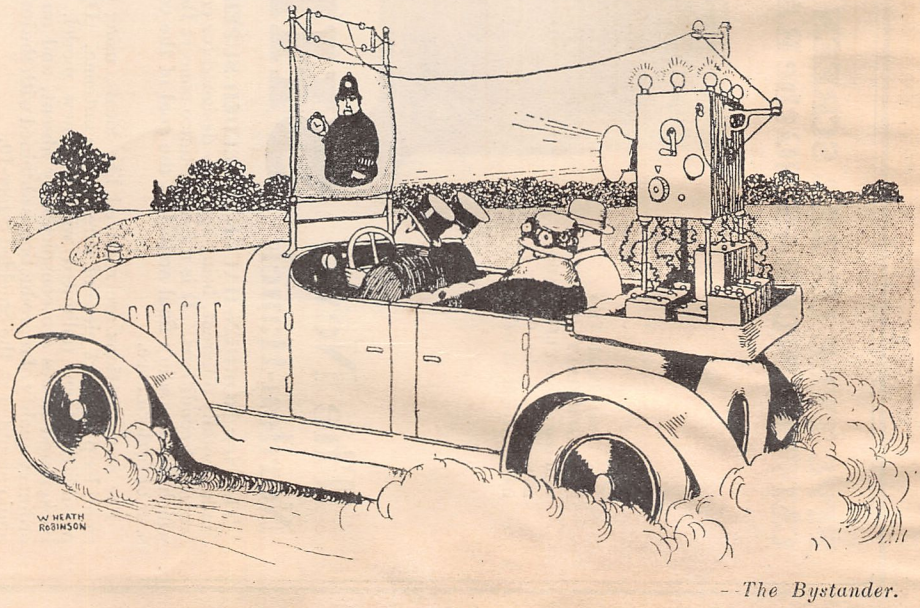
A New Radio Gadget

FROM the columns of our British contemporary, *The Wireless Trader,* we reproduce the illustration of a new accessory, which, as its editor remarks, is long overdue. The vessel is composed of baked red clay, like the ordinary flowerpot, but is equipped with a handle, and filled with the highest quality of ground, in which is embedded a small copper terminal for quick connection to the "ground" terminal of the receiver. This convenience is, of course, especially designed for use with portable receivers; but may, suggest the makers, be used as well for growing rhubarb or hollyhocks. (We would suggest currants, but care must be taken that the fruit does not fall from the shrub and go astray.) As April brings pleasant outdoor and garden

A new portable ground, designed by a British inventor.

weather, as a rule, there should be a considerable demand for this portable ground—especially around the first of the month. Our enterprising American manufacturers will undoubtedly be prepared to meet it.

A Proposed Television Set—"The Motorist's Friend"



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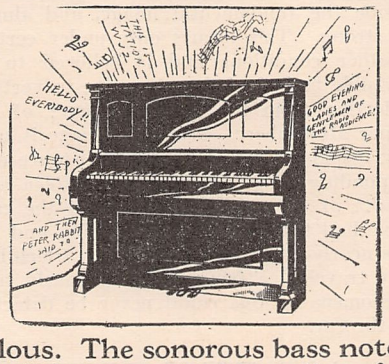
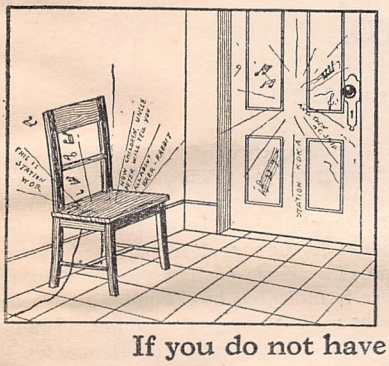


It doesn't show—it does not mar the piano in any way or interfere with its use as a piano. Fits any piano, grand or upright, and works on *any* radio set.

The reproduction is simply marvelous. The sonorous bass notes, the rolling notes of the middle register, and the thin, sharp tones of the upper treble—all perfect—and the voice sounds *natural.* The famous ENSCO drive mechanism—the rugged direct-drive, distortionless unit developed by Clyde J. Fitch, makes this possible. It is *new,* and the results will surely astound you.

MANY NOVEL APPLICATIONS

Musical furniture is now a reality. Imagine the dinner table, surrounded by guests, bursting forth into glorious song, a chair or bridge table telling a bedtime story, or a door or panel singing a baritone solo! All this is made possible by the ENSCO piano unit. It is made by the makers of the famous ENSCO cone speaker kits under U. S. Patent No. 1630199 and others pending.



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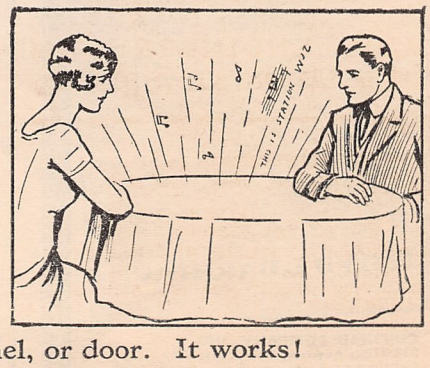

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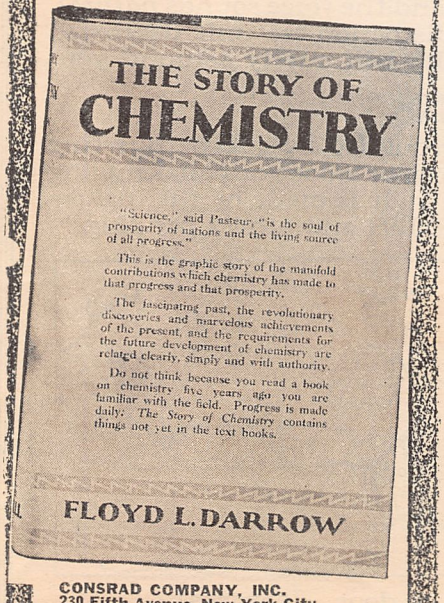
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Television Comes to the Home

(*Continued from page* 1100)

But there is another side to the story. In studying radio reception, as we know it today, static, interference and fading are factors about which very little is known. These are also present in television, but instead of being audible they are *visible.* Not only that, but the eye is more sensitive to differences in shading and minute changes of position than is the ear to differences in sounds. For that reason, the study of the problems of transmission will be made much more effective by the use of television apparatus.

In television "static" appears on the screen as black splotches, which momentarily blot out the image. "Fading," such as that experienced in voice transmission, results in, literally, the gradual fading out of the image on the lens. When the receiver is oscillating or "squealing" the image has more contrast; *i.e.,* the shadings and shadows become a dead black with a corresponding lightening of the "high lights."

Another interesting part of radio transmission, which is brought out by television, is the "echo image." This condition is evidenced on the lens by a *double image, i.e.,* the appearance of a perfect secondary image beside the fundamental image, and almost as strong. This occurs only under certain weather conditions and is believed to be a visible "echo" of the wave due to vertical reflection from the electronic layer of the upper atmosphere. The echo image is usually displaced on the lens to a distance corresponding to a delay of *one fifteen-hundredth of a second;* showing that the echo wave had travelled about 124 miles and yet was nearly as strong as the other, which had only travelled a few miles. Obviously such phenomena as this could never be detected by the ear.

A NEW TYPE OF ANTENNA

Experiments in the fields of television have brought about a new type of antenna, which is illustrated in Fig. E. From the arrangement of the wires it has been named a *checkerboard* antenna; the sides of each square being equal to half a wavelength. All these half-wave antennas are connected in such a way that they oscillate *in phase* and require no tuning.

The checkerboard antenna is *not* a beam antenna, although all the energy is projected in the general direction toward which it is desired to transmit. The angle at which the antenna is arranged is of great importance; for example, the one shown in Fig. E is intended for work with San Francisco and the left side of the illustration is toward the west.

As mentioned previously in this article, there are still many mechanical and electrical obstacles that must be overcome before television apparatus, such as that illustrated here, can be available for ordinary home use. But the important thing is that it is at present a reality, and no longer merely an engineer's dream. In three homes in Schenectady today television receivers stand beside the regular broadcast receiver and, although members of the families at present have to crowd a bit to *see* what is coming over the air, yet the time surely is not far distant when they will be able to sit comfortably before the television receiver and see with the same ease as they hear today.

There certainly can be no doubt that we are on the threshold of a new era. Television has been demonstrated several times before in this country and abroad; but now it has been brought into the home in a manner that can be readily comprehended and by apparatus simple enough for the average man, who is not mechanically inclined, to operate. And that is a real step forward. Although it is the technical man and the experimenter who have made radio what it is today, the layman—who is typical of the great majority of radio enthusiasts—is the one to be pleased and catered to in the perfection of radio utilities.

A Novel Automatic Volume Control

(*Continued from page* 1131)

while with a "voltage-squared" detector, the average rectified voltage is proportional to the average total power of carrier and sidebands. This last feature is worthy of mention in connection with the control system; since the automatic grid bias should depend on only the carrier amplitude, independent of the modulation.

With the circuit constants shown in Fig. 1, the time constant of the circuit which connects the rectifier to the grids of the control tubes is 1/40 second; so that the control system comes nearly to equilibrium in 1/20 second. This time can be reduced further if necessary, but is ultimately limited by the allowable reduction of the signal modulation at the lowest audio frequencies.

In consequence of the automatic control action, it becomes difficult to tune the receiving set accurately by ear to a desired signal. The amplification is decreased as the response to the signal is increased by tuning, and *vice versa;* so that the point of resonance is indicated by minimum plate current in the radio-frequency amplifier. Taking advantage of this fact, a milliammeter (MA, Fig. 1) is connected in the plate circuit of the first tube, to be used as a resonance indicator, and also to give an indication of relative signal intensities.

USE OF "B" UNIT

There is an incidental problem in supplying the plate current to all tubes of the set described, from a common rectifier-and-filter

system. In the controlled radio-frequency amplifier tubes, when operating at low plate current, the signal carrier is modulated appreciably by small fluctuations in the plate voltage. Such fluctuations are caused by plate-current pulsations in the audio-frequency amplifier. In the presence of a strong carrier wave, these two effects may cooperate to generate a low-frequency oscillation. This disturbance may be avoided by reducing the internal output impedance of the rectifier filter, by decreasing the amplification at low frequencies in the audio-frequency amplifier, or by using separate rectifier-filter systems to supply the plate currents of the radio-and audio-frequency amplifiers, respectively.

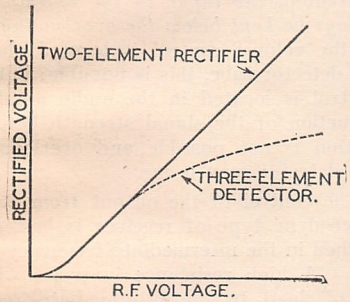

FIG. 3.

The above graph shows the nearly-rectilinear proportionality between the alternating and the simply-rectified voltages as against the output of a three-element detector.

The performance of the automatic volume control as described can be summarized briefly as follows. A maximum variation of signal voltage in the ratio of 1:1000, corresponding to differences in distance, fading, or tuning, results in a maximum variation of the rectified carrier voltage in the ratio of only about 1:3. This small variation, together with possible differences in the degree of modulation of different stations, can readily be compensated if necessary by adjusting the manual volume control for the audio-frequency amplifier, which also determines the "volume level" for the automatic volume control.

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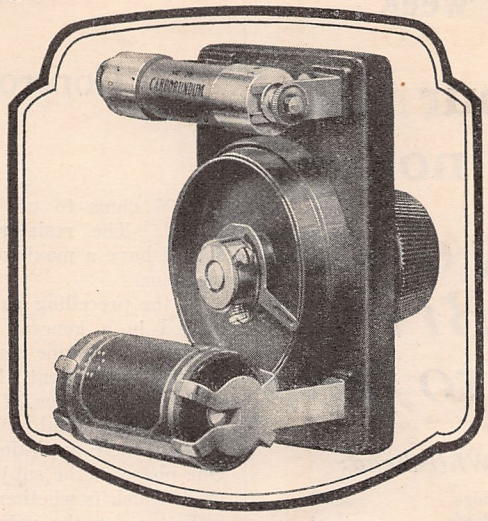

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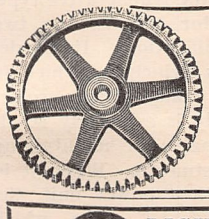

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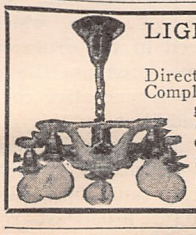

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Attention might be called to British Patent 259,664 (Western Electric Co., July 14, 1925), in which a somewhat similar system is presented. This other system is applied to a superheterodyne receiving set, and is more involved in several respects than the system described in this paper.

It is desired to acknowledge the co-operation of the Howard Radio Company of Chicago, in whose laboratory the set described was assembled.

(From an address delivered before the Institute of Radio Engineers, at a meeting in New York, Nov. 2, 1927, and published by permission of the I. R. E.)

Controlling Volume in Your Receiver

(*Continued from page* 1137)

500,000 ohms to one megohm can be obtained. The resistor used in method B should have a maximum value of about one megohm.

In the preceding paragraphs we have discussed in a general way various common methods of volume control and have pointed out, to some extent, the relative advantages and disadvantages of the various methods. The reader should now have a good conception of their operation and characteristics. One phase of the subject remains to be covered, which is whether, broadly speaking, it is better for the volume control to be before the detector (in the R.F. amplifier) or after the detector (in the audio amplifier).

R.F. METHOD RECOMMENDED

In general, it can be said that the volume control should be placed ahead of the detector. The signals received from local stations are comparatively strong and, after amplification in the R.F. amplifier, the voltage is considerable. A detector tube can handle voltages only up to a certain value, beyond which overloading takes place and distortion results. If the distortion is to be prevented, *the input to the detector must always be kept below the overloading point.* If the volume control is located ahead of the detector tube, this is possible; but if the control is located in the audio amplifier a reduction of the signal strength before detection is not possible and overloading of the detector may occur.

The control of the output from a superheterodyne type of receiver is best accomplished in the intermediate-frequency amplifier. A high resistance in series with the "B+" load to the intermediate-frequency amplifier will serve very well. In many superheterodynes the oscillation control, regulating the amplification in the I.F. amplifier, is used also as a volume control.

Owners of receiving sets equipped with poor volume controls must frequently resort to detuning one or more of the R.F. stages to adjust the volume properly. Such practice is not to be recommended, and a better volume control should be installed in the set.

Why Batteries are Still in Fashion For Short-Wave Receivers

MANY of us have probably wondered why, in the numerous diagrams appearing in the various radio publications, of short-wave receivers, whether designed for short-wave-broadcast or code reception, "B" batteries, rather than socket-power devices, are always designated as a source of plate supply. That there is a good reason for this, however, is indicated by some interesting tests recently made.

In the first place, a short-wave receiver is almost invariably of the regenerative type, consisting of a detector and one or two stages of audio amplification. It is designed on the low-loss principle (which in short-wave reception really means something) and consequently is extremely sensitive and must be capable of maintaining the most critical adjustments. When it is used in connection with a power unit, the remaining unsuppressed A.C. hum, which may be entirely unnoticed in the ordinary broadcast receiver, becomes pronounced and grows in intensity as the regenerative coupling is tightened. In addition to this residual A.C. hum, the alternating-current variations may also be picked up through the antenna system. Many radio fans, who possessed in the old days broadcast receivers of the regenerative type, will probably recall how easily the 60-cycle hum was picked up when the aerial lead-in paralleled the house wiring, even though it might be separated by many feet, and how the proximity of an electric light was sufficient to also cause this effect.

Furthermore, a stable plate current is vital to success in short-wave reception. The tickler is almost always in a state of micrometrically-critical adjustment; consequently, if the plate current is not stabilized and varies ever so slightly, it will cause the tube to spill over, thus necessitating readjustment. As the A.C. input to the power unit is varying constantly and this variation on a smaller scale, is reflected in the output of the device, the impossibility of maintaining a state of critical adjustment is obvious.

This varying voltage is a factor also in broadcast reception on the higher waves, and has caused a few manufacturers of "B" power units to incorporate a regulator or glow tube in their outfits. This glow tube has as its function the preservation of a uniform current flow, but, unfortunately, its current consumption is so heavy that it can be used only in eliminators especially designed for it; as otherwise it drags down the over-all voltage, causes choke-coil core saturation, and intensifies the A.C. hum.

Because of the sensitivity of the short-

wave receivers to all forms of electrical disturbance, background noise must be eliminated whenever it rests within the power of the set operator to accomplish this. Power units, when used on short-wave receivers and highly-sensitive broadcast sets, are inherently noisy, owing to line fluctuations. If some kind of vibrating household device, which operates on the make-and-break principle from the house current, is in use, it will generate strong waves, which will probably be picked up by the receiver through its antenna even when "B" batteries are used. However, when the receiver's plate supply is obtained from the same power source as that operating the interfering device, the interference will be greatly magnified. In neighborhoods supplied with direct current for lighting, because of the fact that connections are *direct rather than through transformers,* interference of this character may attain astonishing volume.

For this reason, additional importance is to be attached to the increasing vogue of constructing the power unit and amplifier as a separate instrument from the receiver proper—R.F. and detector. Not only is there greater flexibility in the use of a phonograph combination with the amplifier; but a small, highly-sensitive short-wave receiver may be used with the amplifier for the purpose of receiving the programs now available from great distances. Even with a stage of R.F. ahead of the regenerative detector, as in the short-wave broadcast receiver described in this issue of Radio News, the amount of current consumed by the two tubes required would be but a small drain on batteries and entail little trouble.

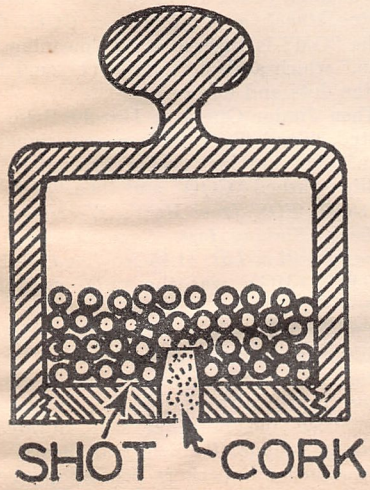
Weighing in Radio Stations

(*Continued from page* 1122)

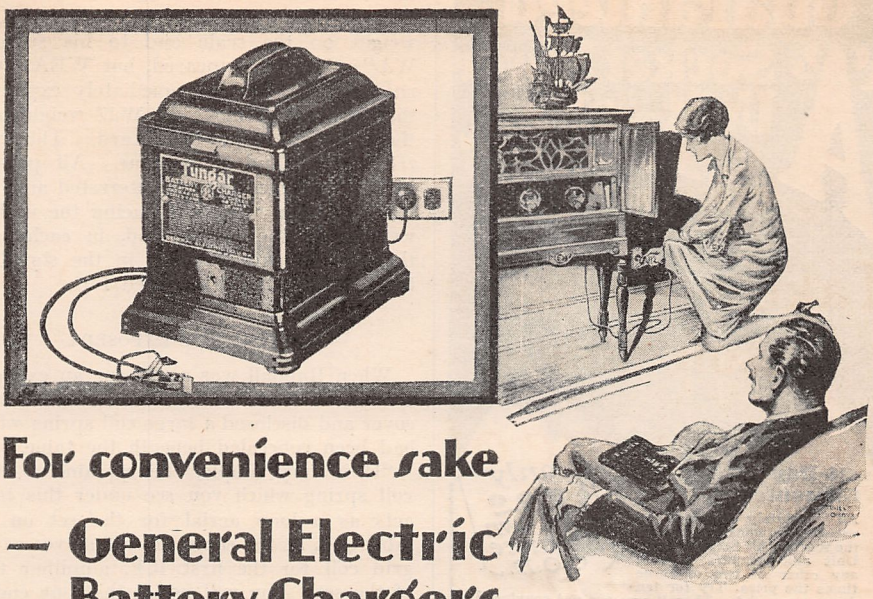
receiver and a cone-type loud speaker. On the other end of the table were a pair of scales and a number of weights, which were labeled with the call letters of the popular nearby broadcast stations.

"Now, gentlemen," continued Randall after the table had been moved to the center of the room, "if you will suggest the call letters of a station you would like to hear, I will endeavor to show how my set operates." Someone called out "WJZ" and Randall selected a weight, placed it on the scales and turned on the filament switch. Much to the surprise of everyone, the signals from WJZ were heard coming from the speaker.

Jack Dallas was the most skeptical mem-



By adding shot to a hollow weight and plugging it with a cork, the tension can be determined at which stations are tuned in.



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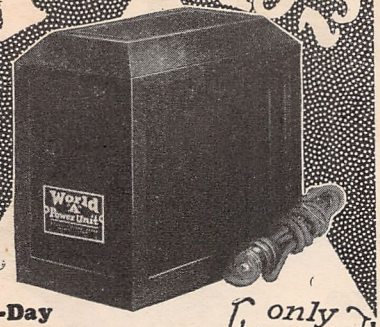

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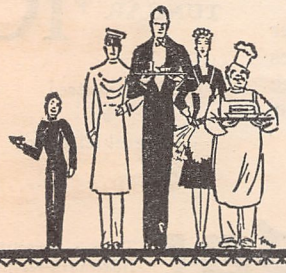

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ber of the party, and he immediately said that he considered the demonstration a fake. To prove his point he placed the WEAF weight on the scale and to his surprise WJZ's signal disappeared, but WEAF was not heard. Randall immediately explained that he should remove the WJZ weight, and then WEAF could be heard. This was tried and found to be true. All persons in the room then became interested and, for the next hour, we tried placing the various weights on the scales; and, in each case, the loud speaker brought in the signal of the station which was called for.

THE SECRET EXPOSED!

When Randall was asked for an explanation of his new receiver, he lifted the table cover and disclosed a large coil spring which had been concealed beneath the table.

"It is very simple," he explained. "The coil spring which you see under this table acts as a loop aerial for the set on the table and, at the same time, it serves as the grid coil for the first R.F. amplifier tube of the set. You will notice that one end of the coil is attached to one side of the scales in such a way that, when weights are placed on the other side of the scales, they will cause the coil to expand in length. Probably you know that the inductance of a coil decreases as the separation between the turns is increased; and this principle is used in tuning the set. A heavy weight placed in the scales will greatly increase the length of the coil and, as a result, tune the set to a low wavelength; whereas a much lighter weight is used for the high-wave station."

"Well, Randall," exclaimed Jack Dallas, "Your set provides a fine after-dinner trick, even if it isn't of much value to the radio industry. Give me the full details sometime so I can fix up a set to fool the folks back home."

"Sure, I'll be glad to," Randall replied: "This arrangement is the easiest thing in the world to fix up, but it takes considerable time to make weights of the correct size. The first thing you need is a loop-operated radio receiver, which may be tuned with a single variable condenser. In most cases the set must have three stages of untuned radio-frequency amplification, as other systems usually require a more complicated tuning arrangement. The size of the spring coil isn't very important; as the set can be adjusted to the desired waveband with the variable condenser and then the weights may be used to select the various stations. Twenty-five turns of aerial wire wound on a hat box are used, and they make a very satisfactory loop antenna."

"There are any number of systems which may be followed in making the weights, and none is very difficult. I used some weights which I found in the laboratory and filled them with a sufficient quantity of shot to tune in the desired station. However, pill boxes, which you can buy at any drug store, would be just as satisfactory and might make the trick even more mysterious; as they are all of the same size. It is also possible to add to the trick by placing a weight in both pans of the scales. Of course, the weight in one of the pans would be the same for all stations, and the weight in the other pan must be changed each time."

"Now that we know what it is, and how it works, tell us how you thought of the idea, and why," someone asked.

"Well, I'll tell you," Randall answered: "Last week, while experimenting with my new invention, I dropped my fountain pen and its weight on some wires changed the inductance of the circuit enough to tune in a new station. That gave me the idea and I could not resist the temptation to have some pleasure at the expense of a few curious persons who have tried to find out what I am doing in the Lab."

When the SOS Flashes

(*Continued from page* 1109)

January 7, 1904, establishing "CQD" as the official distress signal on and after February 1, 1904.

At the Radio Telegraphic Conference in Berlin, in 1906, the German government suggested "SOS" to replace "CQD." German ships had previously used a call "SOE" when they desired to communicate with all other vessels within range. Since the letter "E" consists of only one dot it is easily susceptible to loss by interference; so the delegates suggested that "S" be used as the last letter. "CQD" was superseded in July, 1908, by "SOS," selected as the international distress call by the Radio Telegraphic Convention held at Berlin. (To be exact, this call differs from "SOS" by the fact that the groups of dots and dashes are not separated like separate letters. This gives it a striking and attention-compelling note.)

The acts of the convention were not ratified by all nations until about a year later, so "CQD" remained in force long enough to call rescue ships to the wreck of the *Republic* in 1909.

"SOS" came into prominence when the *Titanic* sank in the North Atlantic, April 14, 1912. As soon as the plight of the big ship was realized, Captain E. J. Smith ordered Operator Jack Philips to broadcast the distress call. Immediately the aerial of the sinking vessel radiated *"Come at once! We've struck a berg! It's a CQD, OM!"* (The "OM" is the radio sign meaning "Old Man," which adds a friendly personal touch to the dots and dashes.)

Then Junior Operator Harold Bride suggested, "Send 'SOS.' It's a new signal and it may be your last chance to send it." So Philips flashed "CQD" and then "SOS."

"CQD, 'SOS' from MGY. We have struck iceberg. Sinking fast. Come to our assistance. Position Lat. 41.45 N., Long. 50.14 W. MGY." (MGY was the radio call of the *Titanic*.)

Philips went down with the ship, but Bride was among those rescued by the *Carpathia*. That tragic scene enacted in mid-ocean proved without a doubt the true value of "SOS," the call that still vibrates the ether as a signal for help and silence.

And so loud speakers become quiet when it sounds, as if to pay tribute to those who have "gone down to the sea in ships."

How Powerful a Tube Does Your Set Need?

(*Continued from page* 1137)

point is reached where, on loud signals, serious distortion occurs, owing to the fact that tubes of this type have a comparatively high amplification factor, so that signals of even moderate intensity drive the grid positive. This overloading, in the case of the 201A type, occurs long before the volume has reached a point commensurate with the requirements of the listener, and before sufficient current is flowing in the plate circuit to reproduce accurately the bass notes. In a broadcast station, for example, only signals of little more than telephone intensity are expected from tubes of the 201A type; whereas, in the set of the average radio enthusiast, they are expected to furnish unlimited volume.

When Radio Turns Street Lamplighter

(*Continued from page* 1120)

months. The receiving circuit is extremely simple and requires no tuning or adjustment. In other words, it is an automatic receiver and the DX fan would scoff at the service of such an outfit, operating at only one frequency or wavelength—40 kilocycles or 7,500 meters—which is outside the broadcast band.

This marks the first commercial application of radio as street lamplighter, but a somewhat similar radio service is operating in Washington, D. C., where the electric-power distributing company has installed two small broadcast stations and equipped its repair trucks with radio receivers, for the purpose of maintaining communication between headquarters and the repair forces afield. These, and developments of a like vein, suggest the daily unfoldings of radio in strange fields and likewise explain the rush by various industries for government licenses to use short waves.

AMAZING STORIES

IN OUR APRIL ISSUE:

The Story of the Days to Come, by H. G. Wells. We are always interested when we read a story of the far future, and of the wonders that might be in store for our descendants. But when such a story is written by Wells, it becomes all the more realistic and the more absorbing.

The Miracle of the Lily, by Clare Winger Harris. Insects are and were man's greatest enemy. What if they should gain ascendancy over human beings once more? The author, who was the third prize winner of our $500.00 contest, weaves a fascinating story around this idea.

The Return of the Martians, by Cecil B. White. Being an astronomer, our author is well informed on the subject and in this sequel to "The Retreat of Mars," he gives us a most unusual, as well as powerfully written, story, which is not too technical.

Baron Münchhausen's Scientific Adventures, by Hugo Gernsback. Our resourceful Baron, in his quest for further first-hand information about the universe, lands on Mars.

The Ancient Horror, by Hal Grant. Prehistoric monsters are no novelty in literature, but here is one so totally different you will not be at all sure that it is not entirely truth.

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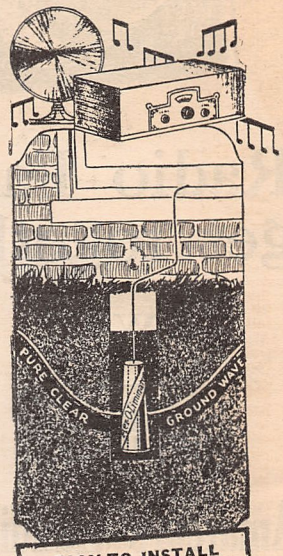

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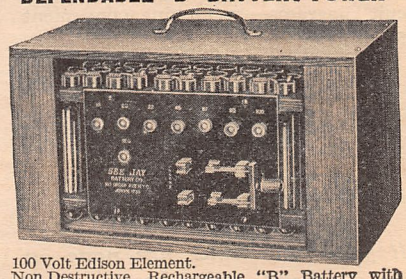

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How to Pick An Audio Amplifier

(*Continued from page* 1142)

circuit shown in Fig. 3 illustrates the way in which it is accomplished.

USE OF AN AUTOFORMER

Fig. 3 shows one stage of an impedance-capacity-coupled amplifier in which an *autoformer* is used in place of the usual audio choke coil in the plate circuit. The autoformer is identical with the usual audio choke coil, except that it is wound with more turns of wire and a separate tap has been provided for connection to the plate of the tube. As the circuit is arranged, the entire winding of the autoformer is connected in the grid circuit of the tube; but only a part of the winding is in the plate circuit. This arrangement produces a voltage step-up in much the same way as does a transformer, the increase in voltage being

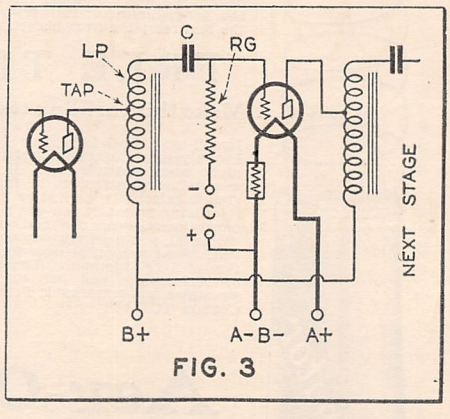

FIG. 3

When autotransformers are used in place of impedance units in an impedance-capacity-coupled amplifier, the above circuit arrangement is employed.

determined by the ratio of the number of turns in the entire winding to the number of turns in the plate section of the winding. In a circuit of this type the amplification per stage is often as high as one and one half times the amplification factor of the tube.

TRANSFORMER COUPLING

Fig. 4 presents the schematic wiring diagram of a standard two-stage transformer-coupled, audio-frequency amplifier. This is probably the most popular type of audio amplifier in use today, and the reasons for its popularity are not difficult to understand. It provides a very simple method for securing maximum amplification from a given number of stages. It is more foolproof than either of the other two systems described, and provides ample volume with two tubes. However, it will introduce distortion if equipment of the highest quality is not selected.

From the wiring diagram it may be seen that the tubes of the amplifier are inductively coupled together by means of a transformer, the primary of which is connected in the plate circuit of one stage and the secondary in the grid circuit of the following one. In the drawing T1 and T2 are the two interstage coupling transformers; and T3 is a 1:1-radio output transformer which prevents the plate current of the last tube from passing through the windings of the loud speaker.

It is not within the scope of this article to discuss the problems of transformer design, but it may be said that the quality of reproduction obtained from a transformer-coupled audio-frequency amplifier is largely dependent upon the electrical characteristics of the audio transformers which are used. Of course, the selection of the proper tubes and the use of the correct grid and plate voltages is just as important in this amplifier as in any other amplifying apparatus, but it is equally necessary to have correctly-designed transformers.

PROPER TURN RATIOS

In the transformer-coupled amplifier the amplification per stage is equal to the amplification constant of the tube multiplied by the ratio between the turns of the secondary and those of the primary windings of the transformer. Thus, if a 201A tube is used in the first stage and the coupling transformer has a turn radio of 3:1, the amplification of the stage will be equal to 3 multiplied by 8 or 24.

Several years ago, when the public learned the fact stated above, it gained the impression that, in order to increase the volume of a set, it would be only necessary to employ a transformer with a higher turn ratio; and the poor results which were obtained with high-ratio transformers were largely responsible for the "black eye" which transformer-coupled amplifiers received at the time resistance-capacity coupled amplifiers were first introduced to the radio set-building fraternity.

It has already been explained that transformer design is too large a subject to cover in this article; but it must be pointed out that the turn ratio of a transformer does not determine its quality. The fact is that, the higher the turn ratio of a transformer, the more difficult it is to build a unit which will give good reproduction. Usually it will be found that transformers with a high turn ratio have insufficient turns on the primary winding and have a large capacity effect between the primary and secondary windings, with the result that the instrument gives very poor efficiency on both the high and the low tones and in the middle range the amplification is full of resonance peaks which distort the music. Voice and music from such an instrument is often distorted to a point where it bears but slight resemblance to the original.

On the other hand, the reader should not gain the opinion that all low-ratio transformers give good quality, for such is not the case. There are many good transformers of the low-ratio type, and there are many which do not give ideal reproduction. For an example, we will say that one manufacturer makes two different types of 3:1 ratio transformers. Both transformers are the same size, shape and approximate weight; but one delivers only average quality and sells for about $3, while the other delivers practically perfect quality and sells for $10. In the case of these two transformers the color of the case is the only way in which they may be distinguished by external examination; so it may be seen that the person who desires best results must buy quality equipment and cannot

judge the efficiency of a transformer himself.

It must also be explained that the range of frequencies over which uniform amplification is obtained in a transformer-coupled amplifier is never as great as in a resistance-capacity-coupled-amplifier. However, this is not always an undesirable characteristic. A modern broadcast station transmits frequencies only within the band of 30 to 5,000 cycles; and there is no reason why the audio amplifier of a radio receiver should reproduce over a wider band. In fact, when an amplifier reproduces sounds having a frequency of 8,000 cycles, many circuit noises and hissing sounds are amplified; and these cause interference with the music. Therefore, if a transformer which amplifies efficiently over the range mentioned is selected, it is possible to have reproduction which closely approaches the original.

Home Radio Photography

(*Continued from page* 1103)

would be of benefit to people who live in places where newspapers arrive too late in the day to inform them of the current programs.

At the present stage of affairs, radio experimenters cannot hope to build photo-radio receiving apparatus of the kind described in this article. The Moore neon lamp, which is the heart of the equipment and which is absolutely necessary for its successful operation, is not available at all; and, according to such high officials of the Radio Corporation of America as David Sarnoff and Dr. Alfred N. Goldsmith, it will not be available for private use for several years. Besides, special mechanical, optical and photographic apparatus, such as only a very fully-equipped physics laboratory would possess, is essential for the construction of the picture receiver.

RADIO NEWS, therefore, requests its readers not to write in for further details of the system described in this article. No constructional information of any kind can be obtained from the designers of the apparatus, and even if it were available, it would be of little practical value. When television and radio photography develop out of the laboratory and single-demonstration stage, and when regular experimental transmissions are inaugurated, then RADIO NEWS will supply its readers with practical data which will enable them to construct working machines. Until such a time, the editors will discourage the publication of half-baked information dealing with so-called television and photo-radio equipment which never existed outside of the designer's imagination, and the materials for which can be procured only by someone possessing a skeleton key to the General Electric laboratories.

A VOLUME CONTROL

Loud speakers, gramophones and dogs are forbidden in some West Surrey flats. We understand, however, that the tenants are allowed to play cards, on the condition that the game is whist.—*London "Humorist."*

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RED RIDING HOOD: "What big ears you have, grandmother!"

GRANDMOTHER: "All the better to listen-in with, my dear."—*Popular Wireless*, London.

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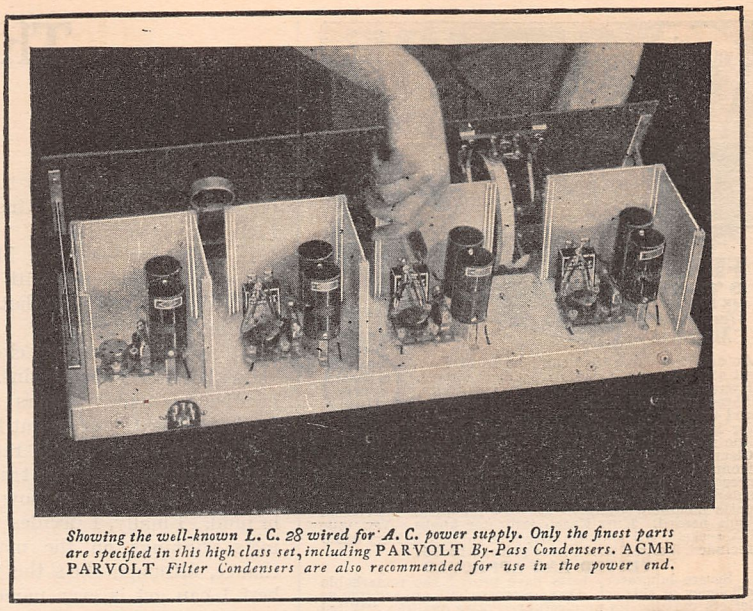

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The Old Dray Mare

(*Continued from page* 1111)

the rush act. They tries to pocket her, but don't succeed; again I wins, this time $250. Little Joe is very happy.

I don't even see The Master all morning, though I mingles with the gang at the fair exhibits, and eats hot dogs until I'm barking.

At noon it starts to cloud up, and for about half an hour it rains. Not hard, but enough to muddy things up considerable. I tries to locate Jerry, but he's disappeared.

The rain stops before race time, and the sun comes out, but the track's slow, and I ain't got any dope on how Fuse Plug acts in mud. Finally, I decides to slip my morning's winnings on the mare, and take a chance, although she's the favorite and the best I can get is even money. I'm figuring strong on the external impulse.

There's only seven in this race, and none of them seems to be a mudhen. They starts, with Fuse Plug bringing up the tail end, no better nor any worse. They're slowed, but as a whole; up and around the bend they splashes, the mare trailing, until they comes abreast of the lab truck.

Then the nag gives the expected lunge—and how! Fuse Plug takes half a dozen frantic leaps, forges to the front, her mouth frothing. Twenty feet from the tape, four lengths ahead of the rest, Fuse Plug stops, flops, and slops—in requiem, so to speak.

The grandstand rises *en masse* as the field thunders past, but Fuse Plug has been blown out.

They carts her remains to the stables, but before they can do anything The Master exhibits his detective badge—he's an employee, and valued, of a well-known international agency—and makes for the corpse. The owner and trainers make futile efforts to hold him back, but with the aid of the local sheriff he gets there.

Quickly he removes the saddle and examines it.

"As I thought!" he exclaims, triumphant. We're shown two small copper contacts, about three inches apart, on that portion of the saddle that is directly over the horse's backbone.

There's a noise in the crowd, and a big, portly guy breaks through. He eyes us sternly. "What's this?" he demands.

Jerry shows his badge. "I have been endeavoring to ascertain the secret of this horse's former spurts of speed," he explains. "I have found out."

He shows the fat man—who happens to be the mayor—the saddle. The official grunts. "Battery, eh?"

The Master shakes his head. "To the contrary, no. Strange as it may seem, Fuse Plug was controlled by radio!"

This statement gets a stir outa the crowd, but nobody gives him the bird. The mayor squints at Jerry, and spits out a wad of tobacco.

"Radio?" he queries. "Whadda ya mean, radio?"

"Just that," replies The Master. He rips open the saddle, displaying a network of fine insulated wire, the two ends of which terminate each at one of the copper contacts.

"This," explains Jerry—and, give him credit, he holds his audience—"is a secondary coil, part of an alternating-current inductance. It is half of an ingeniously-contrived step-up transformer.

"Shortly after the first race, when I had by test established the method that was being employed, I searched the old stable across from the turn. Concealed therein, and plugged into the lighting circuit, I discovered the primary that actuates the secondary here in the saddle. There was other apparatus deftly connected with it, in such a manner and so wired that when the current was on, and the horse passed the barn, she received directly through her spine a very strong shock—I have not yet determined the exact potential. But it was sufficient to spur the mare on and, as the pressure lessened with distance, common sense must have kept Fuse Plug running until the distance eliminated the induction."

There's a round of applause, but the mayor's still there with a question.

"You said radio," he reminds.

Jerry smiles faintly. "Indeed I did. You see, when I first heard of Fuse Plug I surmised to an extent the method that was being used. On her first race Tuesday I verified my hunch. This morning, before the first race, I discovered the apparatus in the barn. I didn't have time to open a box that contained some part of the device, because I had to get back to my truck to get set for the first race.

"I saw nobody enter the barn, and all entrances were visible from where I was parked; when the primary functioned, and with no one to operate it, I was puzzled, but only for a moment.

"Immediately after the first race this morning I returned to the barn. No one was there. But this time I took apart the box that I previously had not had time to look into. This box contained a radio receiver, tuned to one wavelength, and operating the main switch to the primary!

"The actual control was indeed remote. It took me an hour to find the wavelength the receiver was set for; I returned to my truck, arranged my own receiver as near likewise as possible, set up a loop for direction-finding, and waited.

"On the last race I had but a few seconds to tune and get my directions in, and it had to be done against the interference of the operating primary. But I located the transmitting station—in the Belvedere Hotel across the street!"

No sooner said than a deputy comes up with a small, scraggly guy handcuffed and surly. It develops, after questioning, that he is the genius behind the fracas.

Until then it hasn't dawned on me that I've lost all that I made. I turns to The Master, forgetting our agreement.

"Say, Jerry, how come the nag passed out?"

There's others that want to know, too. The Master smiles, and then gazes sadly at the remains of the horse. Jerry loves animals.

"In planning their radio control, the conspirators were very clever in making plans for their personal safety," he states. "But evidently they thought their scheme so secure from detection that they didn't even

bother to visit the barn to look at the apparatus before each race."

"Didn't dare," mutters the radio operator. "Looked suspicious."

The Master nods. "As I surmised. But the rain leaked in on the wiring, and caused a 'short' when the switch was thrown in. Since water increases the natural conductivity of earth, and the ground at that end of the track was almost a small pond, poor Fuse Plug got it coming and going. It was a bit too much for her old carcass. She tried to get away from it by crossing the tape, as experience had taught her she could. But this time the mare couldn't quite make it."

The mayor shakes hands, and asks us to stay for the big dance in the evening, but The Master hates being stared at, so we breezes back to Long Island, me minus my long green.

"Why didn't you tip me off?" I demands.

"After all your good advice on the subject, I never thought you'd bet on a horse," declares Jerry. "How much did you lose?"

I grunts. "Oh, I'm even—just lost what I made. But like a fool I got generous last night and promised Doris a new set of furniture for the parlor."

"What kind does she want?" asks Jerry, "Mohair?"

"No," I growls, "horsehair!"

(Copyright, 1928, by Robert Francis Smith)

The Radio School Teacher Is Here

(Continued from page 1117)

the expression of all school activities. These attitudes were reflected in the conduct of the children on the way home from school, in their homes and in their communities. Dana S. Merriman, musical director of WTIC, and other members of the station staff are enthusiastic over the success of the course.

Anyone who followed a group of pupils from their school to a home, where they were invited to listen to the radio music lesson, would have noticed that the well-bred ones showed their good manners and that the underprivileged quickly imitated them. They all removed their rubbers outside the door. The boys courteously waited for the girls to enter first. Each thanked the hostess for her hospitality as they left.

CONNECTICUT SHARES HER BLESSINGS

Other states benefit from Connecticut's radio course. The commissioners of education in Massachusetts, New Hampshire and Vermont appointed music supervisors to act with the advisory committee appointed by the Connecticut commissioner; schools in Maine received the lessons also. Private and parochial schools and many homes heard and appreciated them.

Radio undoubtedly will play a larger part in our schools in the future. A large number of schools have heard President Coolidge's addresses, by means of radio receivers loaned for the occasion. One state school official is using radio as a means of "visiting" his schools; he can reach more than a hundred at a time. The broadcasting companies are ready to cooperate with the schools, especially because the schools can be reached in the morning and early

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Charles Hoather, Kingsville, Ont.
"The Eliminator purchased from you some time ago is very satisfactory and in constant use."
A. T. Alexander, Canby, Ore.
"The Eliminator received last June is still working fine on our D. C. current." Sgt. J. McKinney, Q.M.C., Alcatraz, Calif.
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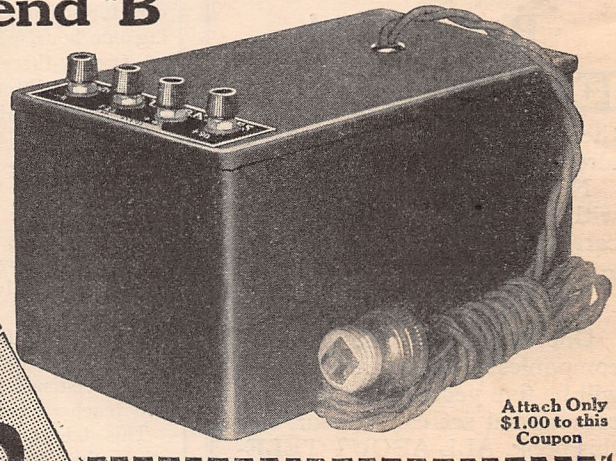

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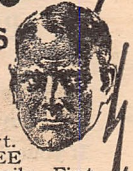

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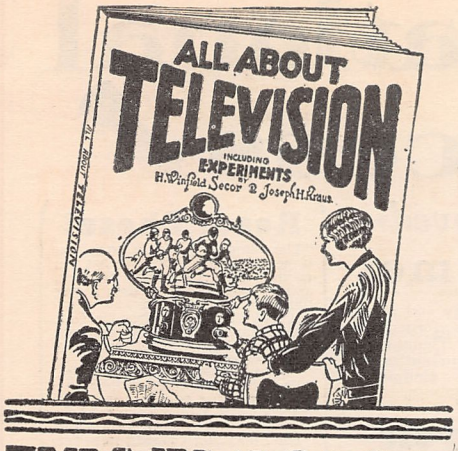

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afternoon when the air is uncrowded and many stations lack an audience.

IF YOU WERE IN SCHOOL TODAY

Think back to your own school days. Education has progressed, but still it fails unless it can secure attention and excite interest. There are 5,000,000 within our borders who seem to be in the same fix as the Florida cracker, who said that there was only one thing that stood in the way of his getting an education. That was "them durned ABC's—there was so many of 'em he couldn't learn 'em."

The burden of education rests ultimately on a teacher with a roomful of restless, squirming boys and girls. They have to be coaxed or forced through text books from which the breath of life has been crushed by excessive condensation. The out-of-doors is calling.

A vaudeville artist has to entertain his audience for about twelve minutes, and he faces a new audience every time he does his act. A school teacher—and many are very young and inexperienced—must interest her group five or six hours a day, five days a week, forty weeks a year, and there must be no deviation from the straight and narrow path that men higher up have laid out for her.

Whether you were a teacher or a pupil, would you welcome a lesson by radio, with music?

Would you like to hear Coolidge, McAdoo, Al. Smith, Will Rogers, Byrd, Amundsen, Lindbergh? Would you?

The State of Connecticut has shown us what to do about radio education.

A Nation-Wide Experiment in Radio Music for Schools

ONE of the most ambitious experiments with radio as an adjunct to its regular teaching facilities was made by the New York public school system on February 10 last when Walter Damrosch led the New York Symphony Orchestra in a concert for school children. The program, lasting one hour, was radiated over a network of twenty-three stations, including WJZ, and heard throughout the entire Eastern half of the United States.

Mr. Damrosch's audience numbered at least 500,000 pupils in the seventh and eighth grades. New York City alone was represented by 110 schools, whose combined audiences totaled more than 100,000. Telegrams reporting reception of the concert were received from as far West as Fairbury, Neb.

A message from the Listeners League in Des Moines, Iowa, said: "All the city schools listened to your program. Children and teachers are enthusiastic."

This telegram was typical of scores of others that flooded in from the West, South and East and from the New England States. In Worcester, Mass., the pupils of several schools which were not equipped with receiving sets marched in a body to the City Hall, where the program was reproduced for their benefit. From Council Bluffs, Iowa, four separate messages from the pupils of different schools requested Mr. Damrosch to continue the programs in the future.

PLANS FOR NEXT SEASON

Immediately after the concert Mr. Damrosch expressed himself as pleased with the response which was pouring in by messenger, telegram and telephone. He spoke optimistically of his plans for the coming year.

"My plan for next Fall, if consummated," he said, "is to conduct twelve concerts for grammar school children, to be offered during school hours and to be broadcast as widely throughout the country as possible at that time. I hope we shall be able to go as far West as the Rocky Mountains—perhaps even to the Coast.

"Over a like period I hope to conduct twelve concerts for students of high school and college age. The idea is not to present music in these programs which will differ widely from that which was just broadcast for the children, but to make explanations more suited to listeners of more matured minds. The lecture concerts will be accompanied by sets of questions and answers in order that instructors may, if they choose, give examinations on the course.

"I should like to bring out most clearly that what I plan is not designed to supplant whatever musical training may already be in the course of instruction but rather to supplement the teachers' work. It is 'the little red school house' in the rural districts that interests me most of all, for these are districts where good music by a great orchestra is so seldom heard."

SPECIAL INSTALLATIONS

Many cities throughout the country installed radio apparatus in the schools especially for this event. Among these were Des Moines and Davenport, Iowa; Nashville, Tenn.; Baltimore, Md.; Worcester, Fitchburg and eighteen other cities and towns in Massachusetts. Other telegrams reporting enthusiastic reception of the concert came from Georgia, where radio has been used in the city schools of Atlanta for more than two years.

The enthusiasm outside of New York, however, was no greater than that displayed in the 110 schools of that city which heard the concert. George H. Gartlan, director of music for the board of education, said:

"The children who heard the concert were delighted, and we are already making plans for the broadcast next Friday. There is no question of its educational value. We are recommending to the board of estimate that all new school buildings be equipped with radio. Equipping the old schools with adequate receiving sets is a matter that will require some time because of the great expense.

"From time to time I have suggested to local neighborhood organizations, chambers of commerce and other civic organizations that it might be advisable for them to interest themselves in the movement to equip schools in their districts with first-class receiving sets. Up to the present time these appeals have met with but little response. The enthusiasm with which the children received today's program should do much to stimulate interest among these bodies."

Whispering Across the Hudson River

(*Continued from page* 1123)

The units operating the loud speaker are of the electro-dynamic type and of a new construction. In its present form the loud speaker uses a huge horn, as may be seen in the accompanying illustration. The moving diaphragm or armature of the receiver is not made of magnetic material, but consists of a sheet of very light aluminum alloy, about two thousandths of an inch thick and so constructed that it moves back and forth, somewhat as a piston. Attached to the diaphragm is a small coil of strip aluminum wound edgewise and insulated with varnish. This coil lies in the field produced by a very powerful electromagnet. (See Fig. 1 for the disposition of the various parts.)

During the operation of the speaker the voice current passes through the small aluminum coil, causing the diaphragm to vibrate to and fro. Because of the plunger-like motion of the diaphragm and the special shaping of the air chamber between the diaphragm and the mouth of the horn, the resulting efficiency is many times greater than that obtained in other types of loud speakers. The large load-carrying capacity of the speaker arises from the fact that the aluminum coil lies very close to the heavy iron pole-pieces of the electromagnet.

This loud speaker is designed expressly for public-address systems and for the reproduction of speech and music in connection with "talking moving pictures." It is interesting also because its reproducing qualities are as fine as its capacity is enormous. It reproduces frequencies from 60 to 6000 cycles without distortion, and reproduces down to 40 cycles and up to 8000 cycles with distortion so slight that it is almost impossible to detect it.

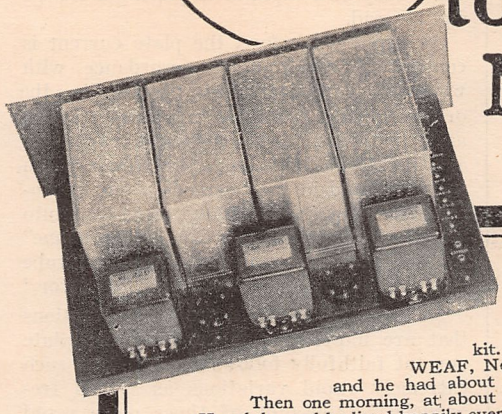
A LESSON IN QUALITY

During the recent exhibition the musical qualities of the speaker were displayed by using it to reproduce the pure notes of an electrical oscillator, the frequency of which was varied from the lowest to the highest pitches. The importance of using such a reproducing device for obtaining good musical quality was demonstrated by cutting out from musical selections certain frequencies by means of electric filters. With these filters any frequency or band of frequencies can be taken from the music or voice. For example, in the case of voice reproduction, it is possible to take out all the sibilant ("s") sounds or, in musical selections, to eliminate either all the high or all the low notes, etc. This is a striking object lesson in the nature of "quality."

An interesting side-light on the demonstration was obtained when an engineer in New Jersey spoke into a telephone connected directly with the laboratory on the other side of the river. This phone was connected to the input of the giant speaker and the engineer across the river heard the Gargantuan echo of his own voice, five or six seconds after he had pronounced the words. It took this length of time for the sound waves to travel back from New York to the New Jersey shore from the mouth of the horn, though the electrical reproduction had been practically instantaneous.

SM

And he too was from Missouri!



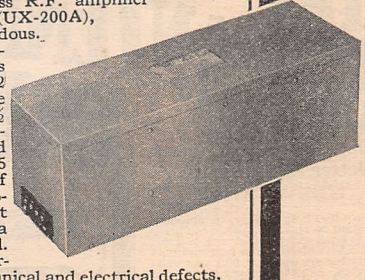
ONCE upon a time—to make a long story short—a man living in Missouri didn't believe, he had to be shown. So he bought a 630-SG Shielded Six kit. The first night he listened to WEAF, New York, and KFI, Los Angeles and he had about thirty-five more—near and far. Then one morning, at about 3:00 A.M., he tuned in KGU in Honolulu, and he lived happily ever after.

That is the story of not one, but literally hundreds of owners of the new Shielded Grid Six. The set is absolutely so good that there is practically nothing like it. Coast to coast with a small loop or a 15-foot indoor antenna, under average conditions is regular performance. Japan and Australia fairly regularly on the west coast; east and west coasts, Canada. Cuba and Mexico from Illinois—these are the reports that pour in day after day. The Shielded Grid Sixes are easy to tune—only two dials—no repeat points—no wide spreads on locals—tonal beauty that is startling in its natural reproduction. They're the closest to the "ideal" set you'll hear for many a day to come.

Your Shielded Grid Six is ready for you in either of two models. The 630-LSG is the generally preferred loop model kit; lists at $91.50; and the 630-SG, which is the antenna model kit, lists at $97.00. Both unconditionally guaranteed against mechanical and electrical defects.

112 Kilocycle Amplifier Catacomb for Screen Grid Tubes

Now Silver-Marshall offers for immediate delivery the famous 112 K.C. time signal amplifier catacomb, improved and refined to take full advantage of the tremendous amplification possibilities of the new screen grid R.F. amplifier tubes. Every experienced fan and professional set builder knows the remarkable efficiency of the famous S-M 440 amplifier, with its high amplification, absolutely accurate peaking, and perfect uniformity, and the new 440-SG model of this famous unit, designed especially for screen grid tubes, is capable of providing *greater amplification than any other long-wave amplifier ever marketed.* The 222 type screen grid tubes are used in the three individually shielded low-loss R.F. amplifier stages, followed by a super-sensitive detector (UX-200A), cushioned socket. The amplification is tremendous. the selectivity hair-splitting, yet tone is well-nigh perfect. The 440-SG amplifier catacomb is laboratory tuned and calibrated to exactly 112 K.C., and either two or three R.F. stages may be used at will. It is 15 in. long, 5 in. wide, and 5½ in. high, with removable cover, finished in beautifully burnished copper. It requires three 222, and one 200-A type tubes, 6 volts at .65 amperes, 135 volts B at only 6 milliamperes and 4½ volts of dry C battery for operation. Its current consumption is so low it may be operated on batteries, yet no finer amplifier can be had for use wherever a sharply tuned long-wave amplifier is needed. Unconditionally guaranteed against mechanical and electrical defects, the 440-SG amplifier catacomb stands unequaled in the long-wave amplifier field. Price $40.00, ready to use, less tubes.



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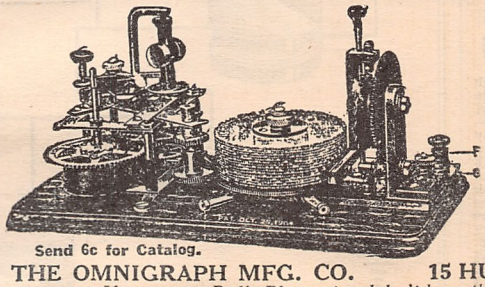

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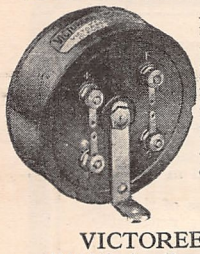

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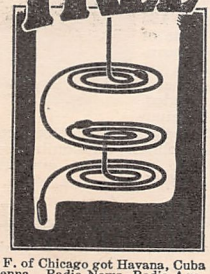

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The Radio Beginner

(*Continued from page* 1125)

of voltage between the filament and grid which may be compared to placing a charge on the grid.

As explained before, the plate current is continually changing in accordance with whatever variations are present in the original signal from the broadcast station; and, therefore, these electrical variations are transformed into *sound variations* which may be heard in the telephones, and reproduce the sounds originally converted into electrical variations by the "microphone" in the broadcast studio. A vacuum tube used in this manner is called a "detector."

No matter how rapid are the fluctuations that are impressed on the grid, the plate current faithfully follows these. Even such extremely rapid variations as "radio frequencies," thousands of times more rapid than the musical or speech ("audio") frequencies, may be successfully amplified also. For further amplification, it would be necessary only to connect the grid and filament of another tube in the position occupied by the head telephones in the case described in the previous paragraph, and the incoming audio-frequency pulsations could be still further amplified by the second tube. There is no limit to the amplification that can be obtained, but various "extraneous" or outside noises are also amplified; so that enormous amplification may give too much importance to useless noises.

VARIOUS USES

Although the action of all common radio tubes is the same in principle, there are other factors which determine which *type of tube* should be used for a given purpose. Certain features of construction or the spacing of elements may adapt a tube to some particular use. Different materials and designs in filament wires may be used; so that different tubes require different battery voltages to operate them. Certain filaments require more current than others for proper heating and "evaporation;" some tubes successfully operate from alternating current merely "stepped down" from the house-lighting circuits, while others require batteries or power units which contain rectifiers.

For *detection,* a small quantity of certain gases, introduced into the glass bulb, often gives a tube greater sensitivity to small grid charges, "weaker signals." A tube to handle large amounts of power, and such are necessary for good loud-speaker operation, must be of special construction so that the plate voltages necessary and the power handled will not *overload* the tube; overloading may give rise to tube failures, or distortion in the speech or music.

One of the governing factors in the use of a tube as a radio-frequency amplifier is the *capacity* between the elements of the tube. A special construction may, therefore, give better results for such purposes. It is evident, therefore, that the design of a tube is greatly influenced by the use which is to be made of it; it may justly be said that there is a particular tube for each and every use in a radio receiver if best results are to be obtained.

CARE OF TUBES

The filament of a tube is designed to give best results at a definite voltage or current, and at this value, a certain length of life for the filament is obtained. If the tube is operated at a filament voltage higher than the rated value, the electron evaporation is greatly increased, with little useful gain; but the life of the filament is very greatly reduced. Some filaments do not actually burn out when the voltages are exceeded, but they become "deactivated;" that is, the useful material has disappeared from the surface of the filament. This may often be restored by turning on the tube with somewhat above normal voltages on the filament, and *with the plate ("B") battery temporarily disconnected;* but prevention is much easier than a cure.

The new "screen-grid" tube makes use of

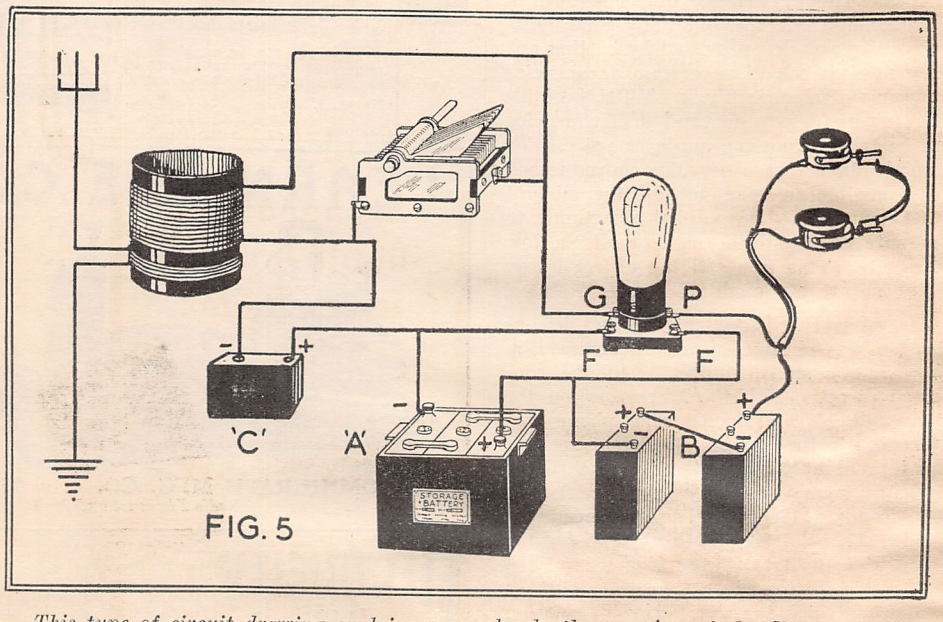

FIG. 5

This type of circuit drawing explains more clearly the meaning of the different parts diagramed in Fig. 4, the connections being exactly the same.

a second grid, which surrounds the plate completely, and shields the first or control-grid from the plate. It thus makes negligible the *"capacitive"* effect between grid and plate, which causes complications in the use of ordinary tubes for radio-frequency amplification. The screen-grid tube, when used as a radio-frequency amplifier, has this second grid connected to a source of positive voltage, about one-third as high as that applied to the plate. The capacitive effect within the tube is thus reduced to a negligible amount. The action of this tube is otherwise the same as that of the ordinary tube, which has been described. (The screen-grid has been explained in more detail, in the article in February RADIO NEWS, mentioned before.)

THE ACCESSORIES

The tube socket is designed so that the tube may be easily removed from it, in case replacement is necessary, and is equipped with convenient screws for attaching the "lead" wires from the external circuits to the socket; the *springs* of the sockets in turn complete the connection to the tube's *prongs*, which lead by wires inside the tube to its elements, respectively.

Two prongs in the ordinary tube connect to the ends of the filament, sometimes designated as "plus" and "minus" when in use, and one each to the grid and to the plate.

The most common type of socket is the "UX." It is often necessary to have a socket which is "spring-supported" or "cushioned;" so that ringing or "microphonic" noises from tubes are eliminated. Proper internal construction, resulting in greater rigidity of the tube's elements, has done much toward eliminating this effect.

All common types of tubes fit into the ordinary "UX" socket; but different tubes require different resistances *in series with the filaments* to reduce the voltage applied to the ends of the filament when using a given "A" voltage, such as that furnished by a storage battery. Resistors of various types are available for this purpose and may be changed about for the different tubes, by merely plugging units of the proper resistance value into the convenient holders.

POWER SUPPLIES

As explained before, the filament of a tube must be heated; this is done by passing through it a current of the proper value. Various means are used for furnishing such filament-heating currents; the storage battery has been widely used and the direct current thus furnished is usually very steady and noiseless. Tubes have

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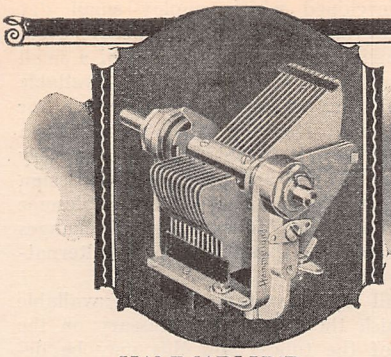
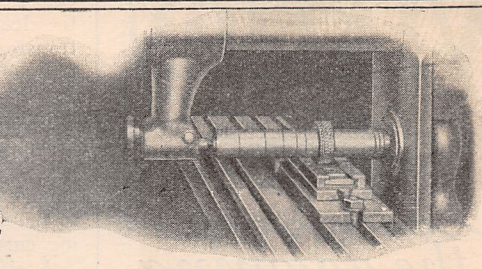

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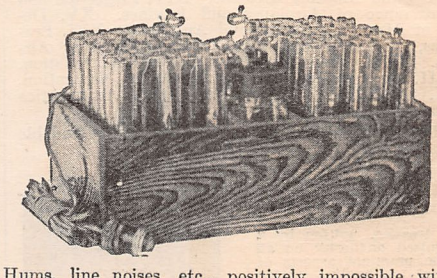

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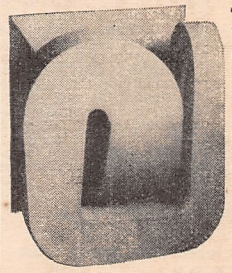

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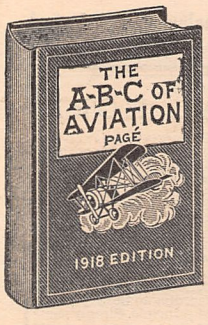

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been developed which employ small dry batteries; and others which operate from the electric-light socket by means of a small transformer, which changes the available house-lighting voltage to a low value for this purpose. The tubes which operate from the light socket, in this manner are very convenient to use, and proper circuit design has practically eliminated the troublesome "hum" occasioned from the rapid changes in the direction ("cycles") of the alternating current.

A still higher voltage must be available to furnish the potentials necessary on the *plates* of the tubes; and this may be derived from "B" batteries, which are simply many small "cells" (usually giving 1½ volts each) all connected *in series* and enclosed in a suitable container. A "B" socket-power unit consists simply of a transformer-and-filter arrangement which gives the proper direct voltages when merely plugged into the house supply. It is possible, therefore, to have a set which is entirely operated from the light socket. Such sets, although somewhat more expensive in first cost, are very convenient and economical in the long run; the only replacement needed on such sets is the tubes and these should last, with care, as long as electric-light bulbs, or considerably more than a year, under conditions of ordinary use.

(An elementary explanation of the more intricate action of a vacuum tube as a *detector* will be found in the "I Want to Know" department of this issue of Radio News, on page 1151.)

Some Suggestions About Resistance Coupling

WITH the advent of better "high-mu" tubes, reliable resistors and high-voltage socket-power operation, the resistance-coupled method of amplification once more comes into its own as a means of obtaining excellent tone quality together with ample volume.

In the first place, the all-important thing with resistance coupling is to employ high-mu or high amplification tubes. Today, for this very purpose, several tubes are available, such as the 240 type, with a mu or "amplification constant" of 30 as compared with about 7 for the usual 201A type, and 20 for the high-mu tubes previously available. Therefore, the present high-mu tubes give a step-up effect 50 per cent. greater; which is essential in a system in which the amplification is solely a function of the tube, without the step-up transformer to help out, as in transformer-coupled amplification.

SELECTION OF RESISTORS

The second consideration is the use of proper resistors; not only in the matter of correct values, but particularly in assuring stability of operation. Resistance coupling is particularly susceptible to changes in resistance, which alter the results and sometimes introduce serious noises. For this reason it is desirable to employ heavy-duty resistors which are capable of providing accurate and lasting resistance values, even when handling considerable currents, without danger of resistance changes to cause noises.

The third consideration, and one of great importance, is to have available sufficient plate voltage. It is often overlooked that, in resistance coupling, the voltage impressed on the plate of the tube must pass through the plate-coupling resistor, the value of which is usually 100,000 ohms and over; in the case of the 30-mu tube, the plate-coupling resistor is of 250,000 ohms. Obviously, to overcome this high resistance in the circuit and still have sufficient voltage to operate the tube efficiently, it is necessary to start out with high voltage (preferably 180 volts) on the plate-coupling resistor, or at the maximum-voltage tap of the usual radio power unit. If "B" batteries are employed, there should be four blocks, of 45 volts each and of the heavy-duty type, to provide the necessary current over a long period of service.

An excellent resistance-coupled amplifier, using present-day components, is shown in Fig. 1. It will be noted that, thanks to the 30-mu tubes now available, three stages of A.F. are no longer required, provided a high-mu detector is employed. Also, it will be noted that a speaker filter is employed (preferably in the form of a choke coil and series-condenser arrangement) to avoid introducing distortion and also to keep the direct-current component out of the loudspeaker. The speaker filter promotes the use of maximum voltage on the plate of the power tube, since the plate current does not have to flow through the high-resistance winding of the loud speaker, as it must when the latter is connected directly to the amplifier output.

RESISTANCE VALUES

The resistance values indicated in the figure do not run as high, in the case of the grid leaks, as those usually specified for the present high-mu tubes. While there is a slight loss in volume, which is certainly not noticeable, there is better assurance of a grid leakage ample to avoid any possibility of "blocking" or the piling up of successive signals.

The layout shown in Fig. 1, comprising a 30-mu tube for the detector, a 30-mu tube for the first stage, and a 171 or 210-type of power tube for the second stage, will provide ample volume, with a tone quality noticeably better than the average transformer and at comparatively low cost.

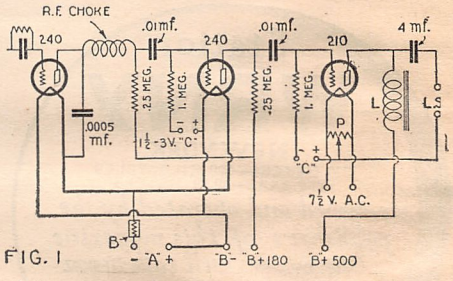

FIG. 1

A two-stage resistance-coupled amplifier, using "high-mu" tubes.

The use of a high-mu detector tube serves to obtain considerable amplification as well as signal rectification. A 3-megohm metalized resistor should be employed for the detector grid leak, in combination with a .00025-mf. grid condenser.

PUSH-PULL CIRCUIT

For those seeking enormous volume, together with a remarkable depth and detail of tone, resistance coupling presents many interesting possibilities in conjunction with present-day high-voltage socket-power operation. In Fig. 2 we present an interesting development in the way of a powerful push-pull amplifier, with excellent tone quality in conjunction with a good speaker capable of handling the full volume. Indeed, this amplifier provides the volume of a small orchestra, with a realism that is quite startling, even to blasé radio enthusiasts. The cost of this amplifier is surprisingly low. With resistance coupling employed in this manner, we remove the possibility of overloaded tubes and therefore the last vestige of distortion in power amplification.

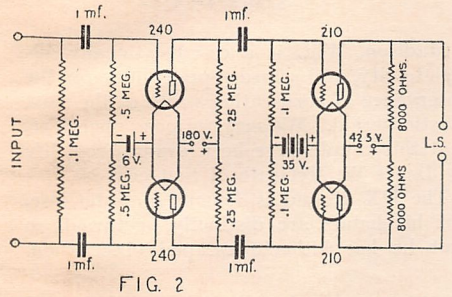

FIG. 2

Complete details of a circuit applying the advantages of push-pull action to a resistance-coupled amplifier. The constants given may be modified by experiment.

The diagram is virtually self-explanatory. It is best to use 2½-watt power resistors for the 8,000-ohm units employed in coupling the output to the loud speaker, in order to handle the considerable current without material change of resistance value. Because of the power handled with this amplifier, none but reliable resistors can be employed.

POWER UNIT

It will be noted that the power must be supplied by a radio power unit capable of delivering 425 volts for the plate circuits and 7½ volts A.C. for the filaments of the large tubes. One 216-B-type rectifier tube will be rather heavily taxed if made to supply two 210-type power tubes, and the plate voltage is apt to drop below the value necessary to operate these tubes at proper efficiency. A 281-type rectifier, substituted for the usual 216-B, will help out in this connection. However, for best results the radio power unit should have two 216-B or 281-type rectifiers arranged for full-wave rectification, which will supply ample plate voltage and current for the operation of two 210-type power tubes.

If we change the "C" battery to 45 volts and the plate voltage to 200, with the output plate resistors 5,000 ohms each, good results will be obtained with two 171 tubes in place of the 210 tubes, for those who must operate on "B" batteries or on moderate voltage radio power units.

While the values given in these diagrams have been found highly satisfactory, there is considerable room for variation.

Incidentally, in Fig. 2 we have not indicated the filament-supply current, but it goes without saying that the first-stage tubes are of the 240 type, operating on 5 volts of battery current, while the two power tubes are operated on either 7½ volts raw A.C. if of the 210 type, or 5 volts raw A.C. or battery, if of the 171 type.

Seattle and Australia Talk; World's Radio Phone Record

Special to The New York Times.

SEATTLE, Wash., July 2.—Radio telephone communication has been established between Seattle and Australia, setting a new world distance record. This was announced today by Frederick G. Simpson, Seattle engineer and owner of Station 7XF in the Grand Trunk Dock.

A two-hour voice conversation was held by E. J. Lesser, manager of the Simpson Radio Corporation, and J. W. Robinson, an Australian amateur. Robinson lives at Concord, about 200 miles from Brisbane. His station is 2RN.

The distance, about 8,000 miles, is the longest over which a two-way conversation ever has been conducted. It is all the more remarkable because the power was only 100 watts. Most broadcasters, with ranges of a few hundred miles, use from 1,000 to 5,000 watts. The wave length of both Seattle and Australian stations was 38 meters.

Mr. Simpson was using a Standard Item 35 as listed in Bulletin 237D. Write for your copy of this bulletin today.

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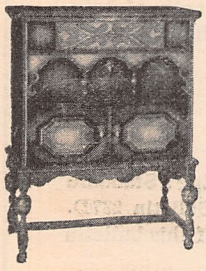

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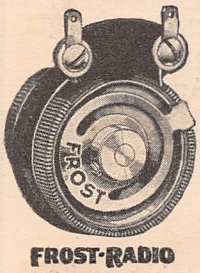

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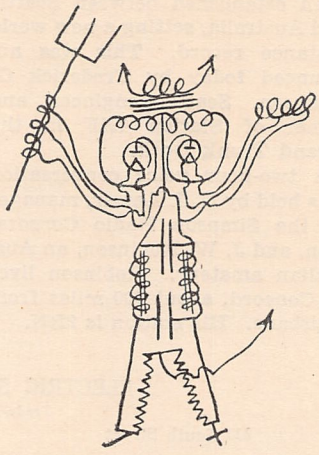
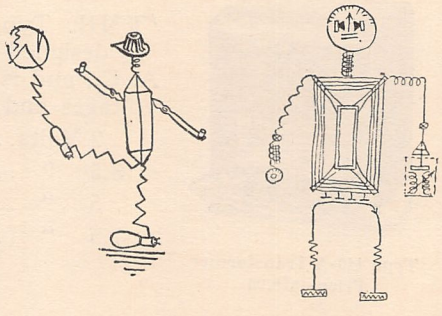
Radio "Bugs"

WHAT is, probably, the best "bug" which the intrepid explorers of Radio Land have discovered for the edification of our readers is given below; and the sceptic who cares to trace the lines will find it a real circuit. The contributing entomologist,



Francis D. Johnston of Pittsburgh, chooses the somewhat intriguing title: "A Dry-Battery Manufacturer's Impression of a 'B' 'Eliminator.'"

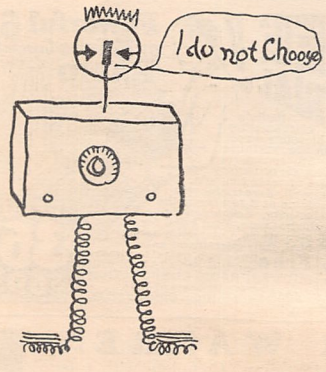
"A Lightning Kick on the Grid-Iron" is the title selected by P. Beck of Herrick, Ill., for this scene of action. It seems to us,



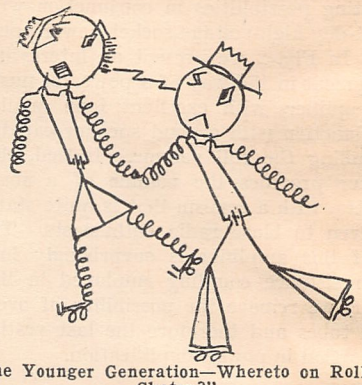
however, that this terrific kick is being bestowed on the filament, which may not survive the indignity.

At the right is a grim hunter; we might have been at a loss to name him, but Jackson Edwards of Tucson, Ariz., supplies the data: "This is a Lou Pantenna, found only in the wilds of Laboratoria. His eyes can detect anything, and he is holding a Peridyne, a weapon against the tribe of Poo Receptionia."

Whether or not the political events of the year will confute the prophets, time alone



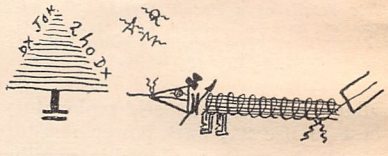
can tell. This sketch of "A Broad-Tuning Receiver," however, will appeal to Demicans and Republocrats alike. It comes from the hasty, though oracular, state of Oklahoma. Audie Robertson of Alex, Okla., is the discoverer.



"The Younger Generation—Whereto on Roller Skates?"

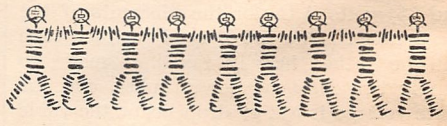
Madison, Wis., is a co-educationally-collegiate city, and affords opportunity for the observance of coruscating youth at the most plastic period. We may suppose, therefore, that this couple have been drawn from life by James W. McGrath of that city.

The DX Hound is famous in radio lore, but his habits are distinctly nocturnal, so that he has hitherto escaped observation.



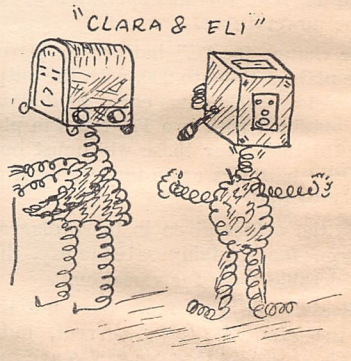
The animal, however, has been drawn during a brief moment of hesitation while stalking his prey. "A true specimen," comments Joseph W. Sine of Salt Lake City. "Observe the distance-getting nose, the crystalline ears and, last but not least, his *tales*, which pass all understanding."

Carl Sipe of Anderson, Ind., pictures a parade of the Thoriated Soldiers, which



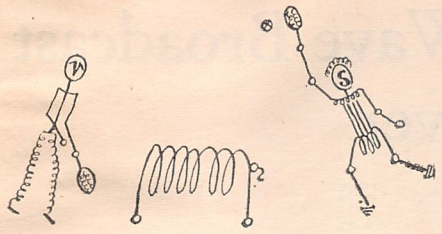
hardly needs the brief explanation: "The Nine-in-Line." Long leads are evidently conspicuous by their absence.

A. J. Manson of Nelson, B. C., pictures a pair whom we took at first glimpse for The Heavenly Twins. The legend informs us



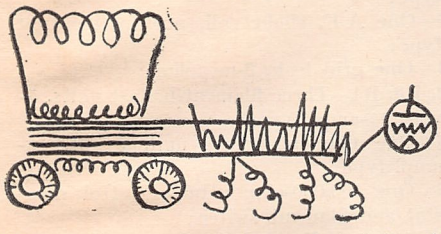
of their full names: "Clarifier and Eliminator get good reception."

Some of our bugs are far from home; this spirited scene, with Tilden on the left and Suzanne on the right, comes from A. Haertel of Offenbach, Germany. But while Herr



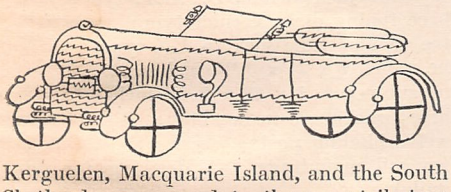
Haertel is fair DX, he is not to be compared with the two which close our symposium.

E. G. Castro of Manila (Philippine Islands), sends in "The Ham's Covered Wagon." Whether it is drawn by a broncho



or a carabao, we cannot say; but it is evidently on its westward way.

A companion piece shows the effect of progress. The radio automobile is the work of a fellow-Filipino, Enrique G. Hinlo of Manapla, Occ. Negro. Pending returns from



Kerguelen, Macquarie Island, and the South Shetlands, we award to these contributors the prizes for greatest distance covered by transmission.

Entomologists, for your labors in the cause of radio science, and on behalf of the radio public—your public—we thank you!

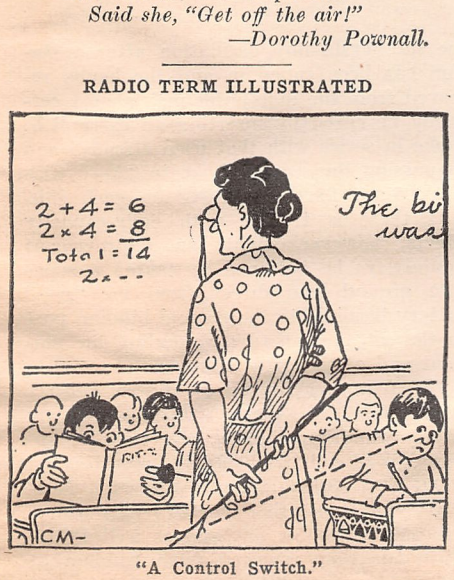
A FILAMENT ELIMINATOR

There was a young radio student
Who was told to be careful, but wouldn't;
On "A+" he placed
"B 90" in haste—
Then he tried to tune in, and he couldn't!
—J. Hope.

TUNING OUT

His voice was full of static—
"Oh, can't you learn to care?"
Her answer was emphatic:
Said she, "Get off the air!"
—Dorothy Pownall.

RADIO TERM ILLUSTRATED



"A Control Switch."

Watch the Last Stage

A LARGE percentage of the distortion, in most radio receivers, is caused by overloading the tube in the last stage of audio amplification. When tubes of the 201A or 112 type are used, the only ways to reduce the distortion may be to substitute a larger tube or to decrease the volume; but with tubes of the 171 and 210 types, the distortion can usually be remedied by correctly adjusting the grid-bias voltage ("C" battery) on the last stage. The instruction sheets, which are packed with the tube, give approximately values of grid-bias voltage suitable for use with various plate potentials; but, in order to make sure that the tube is not being overloaded, it is necessary to connect a milliammeter in the plate circuit of the last tube.

If there is no appreciable movement of the needle of the milliammeter when loud signals are being received, the grid is correctly biased. On the other hand, *when the needle of the meter oscillates as the intensity of the signal is increased,* the tube is being overloaded and the bias must be increased or decreased, as the case may be. If it is impossible to prevent the needle from oscillating by any adjustment of the grid bias, this fact indicates that too much volume is being obtained from the amplifier.

The meter used for this purpose should have a range from 0 to 25 milliamperes, and the maximum fluctuation of the plate current should not be greater than 10% of the total current. In the case of the 171-type tube, the plate current should be 20 milliamperes with a plate potential of 180 volts, and the correct grid bias is approximately 40 volts. With the 210 tube, operating with a plate potential of 425 volts, the proper plate current is 18 milliamperes, and the grid-bias potential approximately 35 volts.

Use of Separate Amplifier

THERE is no unanswerable reason why the audio-frequency amplifier of a receiving installation should be built as part of the radio set; while, on the other hand, it is often more satisfactory to construct it as a separate unit. The practice of combining the audio amplifier with the "B" socket-power unit is now becoming very common, and has received the endorsement of a large number of radio engineers.

With the amplifier and "B" supply device in one unit, the installation is much more flexible; as it may be connected quickly and easily with any type of either radio set, phonograph pick-up unit, or microphone. In addition, this prevents the necessity of rebuilding the audio amplifier every time one builds a new set, and eliminates the danger involved in having exposed high-tension wires between the "B"-supply unit and the power tube.

The reproduction obtained will be no less satisfactory when an external amplifier is used, provided one simple precaution is taken in the design of the receiver; *i.e.,* an R.F. choke coil and a by-pass condenser must be connected in the plate circuit of the detector tube. The by-pass condenser should have a capacity of approximately .001-mf. and be connected between the detector plate and the "A—" lead. The R.F. choke coil should be mounted near the detector tube and connected directly in series with the lead to the A.F. amplifier.

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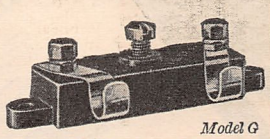

Model G

MODEL "G" VARIO-DENSER

Obtains the proper grid capacity on Cockaday circuits, filter and intermediate frequency tuning in superheterodyne and positive grid bias in all sets. Three variable capacity ranges. Price complete, with grid clips, $1.50.

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The perfect binding post at last! Convenient, simple; permanent connections. You don't have to remember to tighten them. Push down the X-L, insert wire, remove pressure. Connection is tight and will *stay* tight. No vibrations can loosen. Releases instantly. Standard markings, or boxed in complete sets. Price each, 15 cents.

FREE Big new up-to-date book of wiring diagrams of all leading circuits. Write today for copy. Investigate the Goodwin Aperiodic Circuit. This is applicable to any set and adds a stage without added tuning controls.

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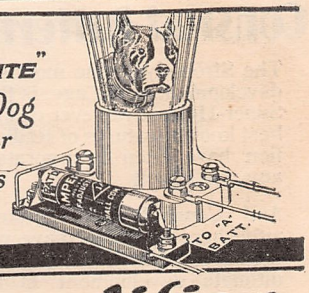

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Only AMPERITE can automatically keep the temperature or voltage of the filament constant despite variations in "A" battery voltage. Particularly essential with eliminators. Proved for 6 years to be indispensable in every radio circuit. Do not confuse with fixed filament resistors. Accept only AMPERITE. Price $1.10 with mounting (in U.S.A.). At all dealers.

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The new improved
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The Strobodyne, the most sensational development of the age, is the greatest Super-Heterodyne ever designed. The best known features of Radio construction have been incorporated in this amazing circuit.

And Consrad, the famous Pattern publishers of Radio, have printed the entire constructional details for this ultimate development in up-to-date Radio efficiency in a new and most convenient form. The new Consrad creation, a handsomely-bound booklet, contains all the details in complete simplified form.

In this Pattern Book are four complete, full-size blueprints and all necessary constructional data required for assembling the Strobodyne—step-by-step instruction.

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Gentlemen:

Enclosed please find 50c, for which please send me the Consrad Pattern Book for the STROBODYNE.

Name.....

Address.....

City.....State.....

An R. F. Short-Wave Broadcast Receiver

(*Continued from page* 1130)

operating on wavelengths between 10 and 550 meters. Six different types of coils and two coils of each type (12 coils in all) are needed to cover this wide band. However, all the coils are not required if the builder wishes to limit the wavelength range of the set to a narrower band. The waveband which each of the six coils covers approximately is as follows: coil No. 1, 10 to 25 meters; coil No. 2, 15 to 33.5 meters; coil No. 3, 31.5 to 68 meters; coil No. 4, 57 to 133 meters; coil No. 5, 125 to 250 meters and coil No. 6, 235 to 550 meters. If it is desired to increase the wavelength range of the set to 725 meters it is possible to do so by connecting a .0001-mf. mica fixed condenser in shunt with each of the tuning condensers (C1 and C2) when coil No. 6 is being used.

In constructing the coils the secondary windings must be spaced. The chart in the drawing gives the number of turns, the size of wire and the length of each secondary winding; and with this data the builder can determine the proper spacing between turns by experiment. The tickler and primary coils are wound with insulated wire and are not spaced. The primary coil consists of 10 turns of No. 24 S.S.C. wire wound on a form 2½ inches in diameter. The tickler coils are merely glued inside the secondaries, or held in place with a few drops of sealing wax or paraffin from a candle.

The following is a complete list of the parts required for the construction of this short-wave receiving set:

LIST OF PARTS

L1, L2—Two sets of coils (see drawing for details);
C1, C2—Two S.L.F. variable condensers, .00014-mf.;
C3—One S.L.F. variable condenser, .00025-mf.;
C4—One mica fixed condenser, .00025-mf.;
T1—One A.F. transformer, 3:1 ratio;
T2—One A.F. transformer, push-pull input type;
T3—One A.F. choke coil, push-pull output type;
R1—One grid leak, 5-megohm;
R2, R3, R4—Three filament-ballast units, 5-volt, ¼-amp. type;
R5—One filament-ballast unit, 5-volt, ½-amp. type;
R6—One 500,000-ohm volume-control rheostat and filament switch;
RFC—One R.F. choke coil, 60-millihenry;
PH—One oscillation control, variable resistor-condenser type;
V1, V2, V3—Three vacuum tubes, 201A-type;
V4, V5—Two power tubes, 171A-type;
SW—One jack switch, D.P.D.T. type;
Three tuning dials, vernier type;
Five vacuum-tube sockets, UX-type;
One panel, 7 x 24 x 3/16 inches;
One sub-panel, 7 x 23 x 3/16 inches;
Three brackets, 3 inches high;
Twelve binding posts;
Two coil mountings (see drawing for details).

FREE BLUEPRINTS

A set of full-size blueprints, covering all the constructional details of the flexible short-wave receiver described in the foregoing article, may be obtained free of charge at the office of Radio News, 230 Fifth Avenue, New York City. Readers desiring to have these prints delivered by mail should send ten cents in stamps or coin to cover the cost of mailing.

Short-Wave Broadcast Information

By E. T. Somerset (England)

IN view of the difficulty experienced by most people in obtaining a comprehensive list of short-wave radio-telephone stations, and the fact that a large number of the readers of Radio News have constructed the short-wave broadcast receiver featured by this magazine, the writer has compiled the list of stations given below, grouped into three divisions, corresponding to the tuning coil which must be used with that waveband.

Of course it must be realized that the bands overlap; for instance, 2XAF may be found to come in at the extreme upper end of the scale with No. 1 coil, as well as at the lower end of No. 2. This is explained also by the fact that different tubes and detector voltages will cause an alteration in readings.

Should the reader be unfortunate enough to experience trouble with what is known as "Threshold Oscillation" (that is to say, the set bursts into oscillation after a station has been tuned in and the hands removed from the dials) this may almost certainly be cured by inserting an extra R.F. choke in series with that used already; and by-passing the second choke to "A—" with a .0005-mf. fixed condenser on each side.

If there is trouble with body-capacity effects, however slight, an improvement can always be obtained by taking a separate ground lead direct from the "A—" battery terminal to the ground binding post on the set, and also by grounding the filament end of the grid inductor.

The following list is, of course, subject to changes, as these transmissions are largely experimental; by the time it appears, WJZ will probably be operating on 22.207 and 18.715 meters. Likewise, Norway's and Denmark's short-wave transmitters will be on the air, and as well PCJJ, which has been removed from Eindhoven;

but the wavelengths are not at present definitely known.

	Meters
Ocean Township, N. J. (WNJ*)	13.88
Rocky Point, N. Y. (2XG*)	16.02
Bandoeng, Java (ANH)	17.00
Berlin, Germany (AGC)	17.20
Malabar, Java	17.40
Kootwijk, Holland (PCLL) (beam)	18.70
Schenectady, N. Y. (2XAD)	21.96
Richmond Hill, N. Y. (2XE)	22.10
Fort Wayne, Indiana	22.80
Houlton, Maine (2XAA*)	23.00
Chelmsford, England (5SW)	24.00
Pittsburgh, Pa. (KDKA)	27.00
Sydney, Australia (2ME)	28.50
Hilversum, Holland (PCJJ)	30.20
(Temporarily silent)	
New York, N. Y. (2XAL)	30.00
Berne, Switzerland (EH 9 OC)	32.00
Sydney, Australia (2FC)	32.00
Drummondville, Canada (CF)	32.00
Zurich, Switzerland (EH 9XD)	32.00
Johannesburg, So. Africa (JB)	32.00
Caterham, England (2NM)	32.50
Coil No. 2 (31.5—68 meters)	
Schenectady, N. Y. (2XAF)	32.77
San Francisco, Calif. (6XAR)	33.00
Malabar, Java	33.00
Melbourne, Australia (3LO)	36.00
Tomsk, Siberia (RA19)	37.00
Paris, France (Radio-Vitus)	37.00
Taipeh, Formosa, Japan (JFAB)	39.50
Lyons, France (Radio Lyons)	40.00
Los Angeles, Calif. (6XBR) (portable)	40.00
Stuttgart, Germany	42.00
Pittsburgh, Pa. (KDKA)	42.95
New Brunswick, N. J. (WIZ)	43.35
Langenberg, Germany (LA)	43.90
Rome, Italy, (1AX)	45.00
Ocean Tp., N. J. (WND*)	46.48
Konigswusterhausen, Germany	52.00
Cincinnati, Ohio (WLW)	52.02
Brooklyn, N. Y.	54.00
Columbus, Ohio	54.02
Melbourne, Australia (3AR)	55.00
Nauen, Germany (AGJ)	56.70
Bound Brook, N. J. (3XQ)	60.00
Council Bluffs, Iowa (9XU)	61.06
East Pittsburgh, Pa. (KDKA)	62.50
Richmond Hill, N. Y. (WABC)	64.00
Newark, N. J. (2XBA)	65.18
Inglewood, Calif. (6XAI)	66.04
Coil No. 3 (57—133 meters)	
Perth, Australia (6WF)	100.00
Spokane, Wash. (7XAB)	105.90
Richmond Hill, N. Y. (2XE)	106.00
Los Angeles, Calif. (6XBR) (portable)	106.00
Tilton, New Hampshire (1XY)	109.00

*Transatlantic phone.

WEATHER BROADCASTS FROM NAA

On February 1 the U. S. Weather Bureau began a series of daily transmissions, in Morse code, from the high-power radio station at Arlington, Va., by means of remote control. These schedules are as follows, in Eastern Standard Time:

8:15 a. m. on 74.7, 37.4 and 24.9 meters.
10:00 a. m. on 2,677 and 18.6 meters.
11:00 a. m. on 24.9 meters.
8:15 p. m. on 74.7 meters.
10:00 p. m. on 8,238 and 2,677 meters.
11:00 p. m. on 74.7 meters.

The 8:15 broadcasts, morning and evening, are in the regular Weather Bureau code; those at 11:00 in the International code, especially for the use of European weather bureaus, and are repeated from the Eiffel Tower in Paris. Further details may be obtained directly from the Weather Bureau.

Short-Wave Data Wanted

RADIO stations in many parts of the world are now broadcasting on short wavelengths (*i.e.*, below 200 meters); but because most of their transmissions are still only of experimental nature, RADIO NEWS has found it difficult to obtain, even from the stations themselves, accurate information about their operating frequencies, hours of broadcasting, etc. Readers owning short-wave receivers are therefore requested to report to RADIO NEWS any strange *short-wave broadcast* (not code) stations they may hear; giving the wavelengths as closely as they can guess the figures from the dial settings, by comparing the latter with the settings for such consistent transmitters as KDKA, WGY and WLW. These reports can be written conveniently on the backs of postcards.

RADIO NEWS will publish the data it receives, for the benefit of the many people who have built short-wave receivers and wish to be informed about everything they can expect to hear with them.

Convenient Phonograph Socket

A FAN who attempts to use the audio circuit of his radio receiver as an amplifier for phonograph music often finds it inconvenient to remove the detector tube each time he desires to insert the plug from the pick-up unit in the detector socket. This may be avoided by mounting an additional vacuum-tube socket on the baseboard of the set, and connecting it in *parallel* with the detector socket. With the receiver arranged in this manner it is necessary only to turn out the filaments of the detector and R.F. tubes, by means of a rheostat on the front panel, and insert the plug from the phonograph in the extra socket.

Special Sets for Navy

TO prevent its seaplanes when forced down in flight from being without means of communication, the United States Navy will equip them with short-wave transmitters having hand-driven generators for an emergency. The standard frequency will be 8,770 kilocycles, corresponding to 34.19 meters.

Wholesale Radio Lawsuit

AN unusual scene was staged recently in a London courtroom, when a large installment house dealing in radio and other equipment brought suit against 541 of its customers who had entered into "hire-purchase" agreements, for balances due, varying from five shillings ($1.25) up to five pounds ($25). Judgments were given by the presiding magistrate for payments in monthly amounts, varying from two shillings (50 cents) up, according to the circumstances of the defendants.

An Obliging Radio Artist

"THE Sandman," who carries sleep to millions of tired little eyes, is a very real individual to the wee folks in and around Brisbane, Australia, where he broadcasts at times over the local station. More than that, "he can sometimes be seen perched on the top of 4QG with a small searchlight, signalling to his little radio friends. In return, the youngsters acknowledge 'Sandy's' greeting by waving lights, indicating that they have spotted the signals."

They make $6,000 a year

The facts prove that YOU can achieve *Success* in Radio!

Radio News writes us:

"In looking over the dealer mail received in the last three months we find that the average income of all dealers who gave us their income figures, 38 in number, averages more than $6,000 a year."

(Signed) C. W. EMERSON
RADIO NEWS

Why don't you think this over and say to yourself, "These dealers are no smarter than I am. If I knew radio thoroughly, I could make that much and more. I know that the Radio Institute of America is America's oldest radio school—that it gives the finest radio instruction obtainable anywhere, and the finest and fullest radio equipment.

"I know that RIA is conducted by the Radio Corporation of America and is backed by General Electric and Westinghouse—that their course in radio is complete and entirely covers every phase of radio, including operating, broadcasting, in fact *everything* in radio. I know that I can make progress because everything is told so clearly. I can get this instruction at home, and prepare for success in radio without giving up my present job. I can study when I please and as long as I please. With the tremendous opportunities opening up in radio today, I certainly can't pass up this opportunity to learn more about the RIA course. Here's one coupon I will clip. I want the full facts."

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Dear Mr. Duncan:
Please send me your new catalog. I want to know more about your new radio course.
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New AERO Circuits For Either Battery or A. C. Operation

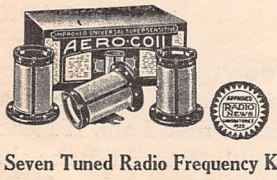
Proper constants for A. C. operation of the improved Aero-Dyne 6 and the Aero Seven have been studied out, and these excellent circuits are now adaptable to either A. C. or battery operation. A. C. blueprints are packed in foundation units. They may also be obtained by sending 25c for each direct to the factory.

AERO Universal Tuned Radio Frequency Kit

Especially designed for the Improved Aero-Dyne 6. Kit consists of 4 twice-matched units. Adaptable to 201-A, 199, 112, and the new 240 and A. C. tubes. Tuning range below 200 to above 550 meters.

This kit will make any circuit better in selectivity, tone and range. Will eliminate losses and give the greatest receiving efficiency.

Code No. U- 16 (for .0005 Cond.).....**$15.00**
Code No. U-163 (for .00035 Cond.)..... **15.00**



AERO Seven Tuned Radio Frequency Kit

Especially designed for the Aero 7. Kit consists of 3 twice-matched units. Coils are wound on Bakelite skeleton forms, assuring a 95 per cent air di-electric. Tuning range from below 200 to above 500 meters. Adaptable to 201-A, 199, 112, and the new 240 and A. C. tubes.

Code No. U- 12 (for .0005 Cond.)..... **$12.00**
Code No. U-123 (for .00035 Cond.)..... **12.00**

NOTE—All AERO Universal Kits for use in tuned radio frequency circuits have packed in each coil with a fixed primary a twice matched calibration slip showing reading of each fixed primary AERO Universal Coil at 250 and 500 meters; all having an accurate and similar calibration. Be sure to keep these slips. They're valuable if you decide to add another R. F. Stage to your set.

A NEW SERVICE

We have arranged to furnish the home set builder with complete Foundation Units for the above named Circuits, drilled and engraved on Westinghouse Micarta. Detailed blueprints for both battery and A. C. operation and wiring diagram for each circuit included with every foundation unit free. Write for information and prices.

You should be able to get any of the above Aero Coils and parts from your dealer. If he should be out of stock order direct from the factory.

AERO PRODUCTS, Inc.

Dept. 105
1772 Wilson Ave. Chicago, Ill.

BIG RADIO CATALOG
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New Zealand Reds — Chinchillas — Flemish Giants
MAKE BIG MONEY—We Supply Stock
and pay you following prices for all you raise: Belgian Hares $2 each—New Zealands $3 each—Cainchillas $4 each—Flemish Giants $5 each. 32-page illustrated book, catalog and contract, also copy of **Fur Farming** magazine, tells how to raise skunk, mink, fox, etc., for big profits, all for 10c. Address
OUTDOOR ENTERPRISE CO., Box 73 Holmes Park, Missouri

Metering The Popularity of Programs

IT has often been asserted that the multiplicity of aerials in a modern city weakens the field strength of a broadcast station by their absorption effect, when all are tuned in to its wave; and some time ago test experiments were carried on in the suburbs of London by British investigators, who reported confirmation of these theories. It is true that in the United States the studies of station field strength have shown a much greater influence upon broadcast waves by the huge masses of steel and networks of electric wires in urban centers. The English engineers are now debating more or less seriously the question whether, if a "load indicator" could be devised, showing the output load on a broadcast station's aerial, it would not be possible to determine the popularity of a program, locally at least, by the number of nearby antennas tuned to its frequency and absorbing power.

This would indeed be a welcome gadget for the station owner, and solve by elimination the problem of luring the elusive "applause card" from the coy listener; but, unfortunately, it must be added, no such indicator has yet been invented. There is an opportunity for our ingenious readers, who are always discovering new hook-ups; but we will have to stipulate that plans and specifications for such a device must be accompanied by a working model before they are considered seriously at the office of RADIO NEWS.

HAUNTED!

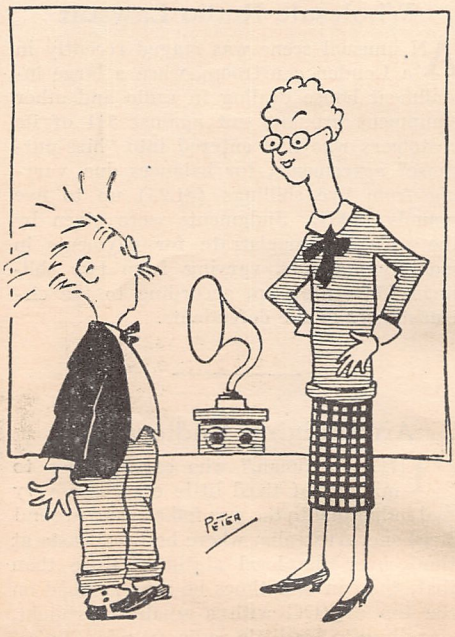
"You haven't forgotten Freddy, then?"

"No, no, even though we've parted forever I still can hear his voice in the still watches of the night."

"Ah, that is the curse of memory."

"Not at all, silly; it's the curse of having loved a radio announcer!"—*Gleason Pease.*

ALL BUT ONE THING



"Now, my dear, do you understand how the set works?"

"Yes, Henry, but how often does the man call to read the wave-meter?"

—*Wireless Magazine, London.*

Dealers

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Gentlemen:

Kindly send me the Radio News—Dealers Personal Edition, for one year, beginning with the next issue. I am enclosing check for one dollar and fifty cents to cover. This I understand is a special reduced price, two dollars and fifty cents being the regular subscription rate.

Name.....

Address.....

City.....State.....

PIN THIS TO YOUR LETTERHEAD

Dr. de Forest Talks on Radio

(*Continued from page* 1113)

amplification and, particularly, better loud speakers. I do not consider any of the cones now on the market come anywhere near the perfect loud speaker. Cones invariably favor some frequencies at the expense of others and most of the cones, while over-emphasizing the bass, put a mask of "paper rustle" over the higher frequencies. Although more expensive, more clumsy, and demanding more space, and altogether less artistic, there are certain types of non-metallic horns now on the market which, with proper loud-speaker units, give far better reproduction than any 18-inch cone. I strongly advocate a radio set built into a large console cabinet with sufficient room to take in one of the larger exponential horns. I know of one or two such combinations of radio and phonograph in one cabinet now being developed, though not yet on the market, which give incomparably better sound reproduction than anything with which the radio public is familiar.

MR. GERNSBACK:—

Dr. de Forest, are you convinced that the present-day alternating-current set is a step in the right direction?

DR. DE FOREST:—As to the technical developments awaiting us in 1928, very rapid progress has been made by a number of leading manufacturers in the solving of the problem of applying raw A.C. to the filaments of the tubes and several first-class sets are now on the market using these tubes, thereby being made entirely independent of "A," "B," and "C" batteries. There is no question that the trend of the industry is entirely in this direction and that, during the ensuing twelve months, we will see the storage battery eliminated, except for the cheaper class of sets. This will be a development which every user of radio must heartily appreciate. The storage battery has from the start been a very serious nuisance in the home and will shortly be quite superfluous wherever electric current, A.C. or D.C., is available. The better type of console radio with built-in speakers, particularly the higher-priced ones with phonograph combined, will be more and more in demand. And as prosperity becomes more widely distributed, and particularly as the educative influence of radio works its insinuative benefits, more and more will the radio public favor the more expensive and properly-designed amplifiers and loud speakers.

MR. GERNSBACK:—

For the next question, Dr. de Forest, the new so-called "screen-grid" tubes make it possible to use much less current than the old-type tubes. Do you think multi-tube sets with little battery consumption a possibility, and that battery-operated sets might yet prevail in the future?

DR. DE FOREST:—Notwithstanding the greater current economy which the double-grid tubes permit, I do not think that multi-tube sets for battery consumption will ever again be popular. I think the day of general use of the storage battery and the dry battery is rapidly drawing to an end. The great convenience and sense of satisfaction in knowing that you are not dependent upon a battery which may give out in the midst of a particularly-desired program, will outweigh any other considerations just as soon as the socket-power units and the A.C. tubes are a little further perfected.

MR. GERNSBACK:—

What are your views on television, in view of the past experiments by Baird of London, and by the research engineers of the American Telegraph & Telephone Corporation? Do you believe television attachments to radio sets a matter of the near future? If so, how soon?

DR. DE FOREST:—I am quite naturally interested, and have inspected the work in television which has been carried on in this country, particularly that by the American Telegraph & Telephone Corporation. I must pay the highest possible tribute to the ingenuity and patient research which has made possible the system employed by the American Telegraph & Telephone Corporation. It is little less than a scientific miracle. Nevertheless, I know my views on television have been somewhat disappointing to those who wish to believe that in the next few years every one can have a moving-picture show at home, broadcast direct from his favorite theatre. Frankly, I cannot foresee such a millennium for the radio fan. Until some radically new discovery has been made in physics, some new principle or operation of which we today have no clear conception, television apparatus must continue to be extremely intricate, delicate, requiring the constant and most careful attention of highly-skilled experts, and be built and operated at very great cost. Until such a new discovery, therefore, I think we must limit our television expectations to an occasional demonstration under the auspices of one of the few great electrical engineering and manufacturing corporations. Television in the popular mind means radio broadcasts of distant scenes as they transpire.

I have little patience with some of those whose names are associated with the history of this new development, who seem willing to impose on the gullibility which the public evinces whenever the word "Television" is used. A few years ago it was impossible to get anyone to believe in wireless telegraphy, and later in the possibilities of the wireless telephone. Of recent years, however, the progress in popular science has been so phenomenal that general gullibility, or willingness to accept any prediction along the lines of invention, takes the place of the skepticism which formerly made the work of pioneers so difficult.

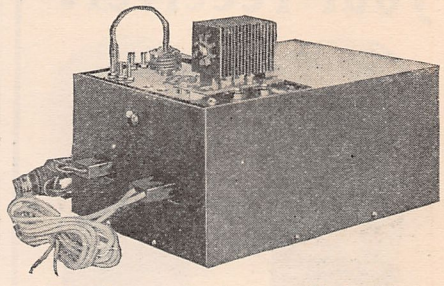
MR. GERNSBACK:—*According to your thoughts, Doctor, I presume what you mean by a new development in physics would be a television apparatus without revolving parts, such as that we have at the present time?*

DR. DE FOREST:—Yes, I think that such a development will eventually be made, but it will be the result of some discovery as radical and as unexpected as was the invention of the X-ray by Roentgen; and not until we have another Roentgen or Michelson who produces or makes a new discovery as radical as the X-ray was at the time he made it, may we bring into existence the television which we all would so gladly welcome.

MR. GERNSBACK:—I think you are a little too modest, Doctor, when you mention as an example the X-ray. Why didn't you say the vacuum tube? You are the one who invented that unexpected wonder. Let me ask you the next question.

What, to your mind, while we are talking

electrify your set the *easy practical* Knapp way....



The Kit completely assembled with metal cover in place. Operates on 105-120 volts AC, 50 to 60 cycles.

Knapp "A" POWER KIT

No expensive short lived AC Tubes, no troublesome re-wiring, no annoying hum. Increase instead of decrease the efficiency of your set, no waiting... the Knapp "A" Power gives you music ***instantly*** at the snap of a switch.

This absolutely dry "A" Power is not in any way a battery combination ... not something to add to your battery ... it is the most efficient "A" Battery Eliminator ever designed. It supplies unfailing "A" current to any set using 201-A or 6 volt tubes, regardless of number.

Magic Silence

So silent is Knapp "A" Power, that you can place a pair of head phones directly across the output and not be able to detect a hum. This is made possible by the efficient Knapp filter system, consisting of 2 over sized chokes and 2 condensers of 1500 microfarads each. A new discovery makes these amazing capacities possible in the small space of 2x2x8 inches!

Absolutely Dry

There is not a drop of moisture in this absolutely dry unit. The condensers are baked so that not a drop of moisture remains. The unique, fully patented, solid, full-wave rectifier is absolutely dry. No water ... no acid ... no alkali ... no tubes ... no electrolytic action. Nothing to get out of order. Nothing that needs attention.

Assemble in Half an Hour

The Knapp "A" Power Kit is so easily assembled, that within half an hour after you receive it, you can have it in operation. The parts seem to fall in place, No drilling and very little soldering. Everything supplied, even to the screws, wire, drilled base-board and metal cover. It is so complete, that even a plug is supplied so that a "B" Eliminator may be operated from the same switch. We have never seen such simple instructions.

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Our president, Mr. David W. Knapp, is offering the set builders of America, for a limited time only, a money-saving, profit-making plan which is unique in the annals of radio. Send the coupon today, before it is too late.

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MR. DAVID W. KNAPP, Pres.
Knapp Electric Corporation
312 Fox Island Road,
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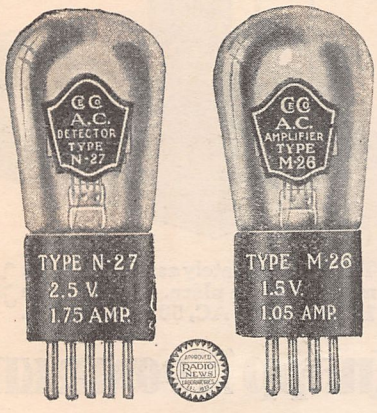

Operating your A. C. Radio Set with a worn or defective tube is like running your car with a missing cylinder!

Replace the defectives with CeCo A. C. Tubes. They will work in harness with any other unworn tubes you have.

But you'll get better results, clearer tone, greater volume, longer life if you CeCo-ize your receiver by putting a CeCo Tube in every socket.

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Con-Rad receivers will pass any test you demand. Try it in your home on our 30 day Free Trial Offer and be satisfied. If you are not, return the receiver to us and the money will be refunded. Write today for complete catalog and details of the Con-Rad Line of 1928 and our liberal 30 Day Free Trial Offer.

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of vacuum tubes, is the ideal vacuum tube of the future? What should be its outstanding point?

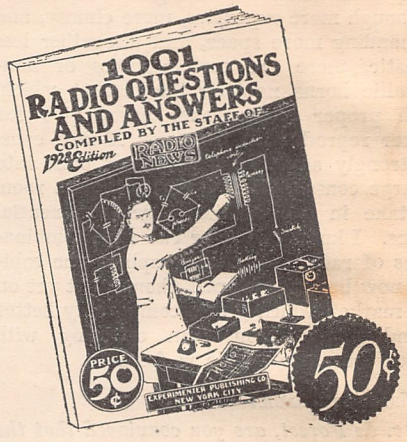
DR. DE FOREST:—I think the ideal vacuum tube of the future should operate without batteries, it should be small, ruggedly-built, absolutely free of all tube noises and non-microphonic. It goes without saying, that it should be operated without overloading and with absolute freedom of alternating-current or direct-current noises. I think that such a vacuum tube will be produced within the next two or three years.

MR. GERNSBACK:—That is very interesting, Dr. de Forest.

May I ask you, what are the latest developments on your "Phonofilm?" Has it been completely commercialized, and where, at the present, is it most used?

DR. DE FOREST:—Answering that question, it has not been commercialized completely, but everything is being done to prove, to most of the motion-picture magnates and authorities in this country, that it is going to occupy a very important part in almost all motion-picture programs in the future. In this respect, the attitude of the men that control the industry has completely changed within the last two years. I might say that great technical progress has been made during 1927 in perfecting talking motion pictures, including the method using phonograph records, and the Phonofilm method of photographing sound-waves on the margin of the film. Both systems have been amply demonstrated before the public in motion-picture theaters, so that it is now fair to draw certain conclusions relative to the practical and commercial possibilities of the two—the one exploited by Warner Brothers as "Vitaphone," and the other by the Phonofilm Company and by Fox under the name of "Movietone." It is only fair to state at the outset that Movietone is a complete copy of Phonofilm, differing in no essential manner from the earlier method, but having been exploited commercially to a much greater degree. The practical advantages of the Phonofilm method over that of the synchronized phonograph in producing, and also in reproduction, have been so clearly demonstrated to those who are familiar now with the actual manipulation of the two methods in studio and theater, as to confirm beyond any question the correctness of my prediction (made in 1919), that the success of the talking picture would lie eventually entirely with the method which photographs sounds on the film margin. With the Phonofilm method an entirely new art and technique had to be developed from the very beginning; whereas, with the synchronized phonograph we had a highly-developed industry of the past thirty years to fall back on. The first six years of Phonofilm pioneering resulted in solving the basic problems and demonstrating to any unbiased technician that the method was practical and could without question be eventually worked out to a point of perfection equal to, or excelling, the phonograph art. Both the modern method of recording and reproducing from the phonograph and that of recording and reproducing from the Phonofilm owe an immeasurable debt to the radio art, or more particularly to the art of vacuum-tube amplification. Without the highly-advanced technique along this line which the demands of radio broadcasting have produced, Vitaphone or the Phonofilm in their present states of perfection would be quite impossible. But taking full advantage of what the radio broadcasting art has

Here are the answers to all your questions



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Here are the solutions to Radio Questions of every conceivable nature.

Have you a question to ask about Radio?—about this circuit, that circuit — this method or that method of Amplification, Balancing, Regeneration, Transmission, Set Construction, Operation, Speaker Design, Control, Electrification, Accessory Installation, Antenna Possibilities—?

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produced along these lines, there still remain very difficult and intricate problems in Phonofilm; particularly as regards the light-recording, sound-photographing means; and the successful taking off of sound from the photographic record on the film. And in between lie many problems in photography, exposure, development, printing, and protecting the sound record.

Great progress has been made in the perfecting of the "photion," or gas-filled lamp, which is placed in the camera and which, when connected to the output of the vacuum-tube amplifier, reproduces perfectly in light variations the electrical values impressed upon its terminals. The photion tube, which I first conceived in 1918 and patented in 1923, has thus far proved its distinct superiority over other methods of telephonic light control, such as the vibrating mirror and the "light-valve." (The latter is a type of bi-filar Einthoven string galvanometer, acting as a shutter to "valve" the light from a fixed source). While the photion is not yet fully perfected, its reproduction, in light fluctuations, of telephonic currents impressed upon it is so nearly perfect, throughout the useful range of audio frequencies, as to justify our faith in its continued supremacy in the field of sound photography. Its simplicity, compactness, lightness of weight, and ruggedness, as compared with that of the vibrating mirror and light-valve, argue powerfully for its continued use in preference to the other types.

Particularly do the above advantages hold for portable Phonofilm or Movietone equipment, where a light, easily-portable camera, to be quickly carried from a truck and set up at a moment's notice for recording swiftly-passing topical events, is absolutely essential. And the success of the audible topical weekly is already so abundantly demonstrated as to prove that, in the future, this feature will become more and more essential in every motion-picture program. Much progress has been made also in the design of compact portable amplifiers for such recording of outdoor news events.

The difficulties in securing perfect motion of the film past the light source in the camera have been eliminated during the past year; so that now it is possible to secure as perfect film motion with a cheap portable projection machine as can be obtained with the finest phonograph turntable.

For use in the projection room of the motion-picture theater highly improved amplifiers with sound "fade-in" and "fade-out" devices have been largely perfected. The Phonofilm amplifier for the theater has been made very compact and fool-proof, requiring practically no skill on the part of the motion-picture operator for its proper manipulation. Back of the screen has seen possibly the most striking advances of any in this art during the past year. New loud speakers of entirely novel design, permitting a naturalness of reproduction which is almost uncanny, have been worked out. A new form of screen, transparent to sound and possessing the necessary optical property to throw a brilliant picture, has been found; so that the sound no longer seems to emanate from one side or the other of the screen, but directly from the mouth of the speaker, wherever he may be in the picture. 1928 will see these various improvements, which I have described, exploited and demonstrated to the public in many hundreds of theaters scattered throughout the country.

The chief remaining problems in the talking-picture art lie, not in the theater or engineering laboratory, but in the motion-picture studio. There scenario writers, producers, artists and cameramen must gradually acquire working knowledge of the new art and how to take full artistic advantages of the countless and immeasurably rich possibilities which this new art has now brought forth, for the entertainment and cultural uplift of the motion-picture public.

Mr. Gernsback:—My final question:

On what particular new thing are you working now, and can you tell us something about it?

Dr. de Forest:—I am working exclusively on Phonofilm and allied problems at the present time. Among these are improved audio-frequency amplifiers and loud-speaker devices which can be used in connection with either Phonofilm or with radio, or the electric phonograph.

What Constitutes Tone Quality?

(*Continued from page* 1135)

portion of the vibrator near B. The lower-pitched waves produced at the rear must travel farther before emergence than the higher-pitched waves generated near B; in both cases the necessary conditions for amplification. It should be noticed that the vibrator board, as a sound amplifier, functions much as does the disc of a fixed-edge cone.

"It may be seen that the horn described is not a simple air-volume resonator, but that it is a combination in a single instrument of a series of air resonators, a reflex horn, a straight horn, a curved horn, a reentrant horn, and a resonating diaphragm or sounding board; and that it makes use of both multiple and cross resonance, all in the effort to secure as nearly as possible uniform tone amplification."

BREAKING INTO GOOD COMPANY

It is evident that Walter Damrosch, conductor emeritus of the New York Symphony Orchestra, derives great enjoyment from his fan mail. He told with particular zest of a South Dakota listener—a plainsman—writing to say that when Mr. Damrosch was broadcasting the "Pilgrim's Chorus" from *Tannhaüser* that he grabbed up "his old cello" and joined in.

"I did that," the plainsman confided, "so that I could say I once played with Walter Damrosch and the New York Symphony Orchestra."

LET THE BUYER BEWARE

ALTHOUGH European listeners are held strictly to payment of a fee for the privilege of owning receiving sets, in Bavaria they are allowed a week's free trial of a set purchased on approval, without taking out a license. In England, however, the radio magazines complain, a number of public functionaries seem to be of the opinion that it is an offense against the law to purchase a radio set without having a license in advance. This places radio apparatus somewhat in the category of revolvers and narcotics.

Enjoy LOUD SPEAKER OPERATION from a CRYSTAL

NO "TUBES" - NO "B" BATTERIES - NO COSTLY "ELIMINATORS" WITH THE SKINDERVIKEN TRANSMITTER UNIT

Simple microphone unit provides a most effective and inexpensive way to satisfactory speaker operation. Easy to build and operate circuit.

Everybody can do this now with a Skinderviken Transmitter Unit. The unit is fastened to the diaphragm of the speaker unit. It will act as a "microphonic relay." Every time an incoming signal actuates the diaphragm, the electrical resistance of the microphone unit will be varied correspondingly and the current from the battery, in series with it and the loud-speaker, will fluctuate accordingly.

Thus the problem of securing sufficient power to actuate the Loud-Speaker is simply and adequately solved.

The results from this very novel and simple unit will astound you.

The expense of this hookup is trifling compared to elaborate tube circuits that give no greater actuation of the speaker.

Besides this there are many other valuable uses in Radio Circuits for this marvelous little unit. Every builder of Radio sets should have a few on hand.

LISTENING THROUGH WALLS

This Unit makes a highly sensitive detectaphone, the real thing—you listen through walls with ease. Plenty of fun and real detective work too.

CONDUCTING SOUND THROUGH WATER

Make yourself a miniature submarine signaling apparatus like those used during the war. Simple circuit with this microphone unit gives splendid results.

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containing suggestions and diagrams for innumerable uses mailed with each unit.

We Pay $5.00 in Cash

for every new use developed for this unit and accepted and published by us.

SEND NO MONEY

Order as many as you want—use the coupon below When the postman delivers your order you merely pay him **95c** plus a few cents postage. If you order two units you pay him only **$1.75,** plus postage.

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Please mail me at once.....Skinderviken Transmitter Units, for which I will pay the postman 95c. plus postage, or $1.75 plus postage if I order two units.

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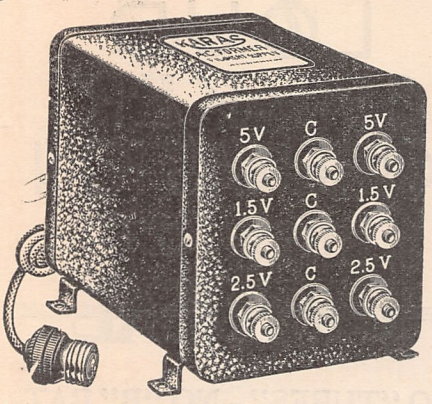
Converts Any Set to AC



The KARAS A-C-FORMER

END battery troubles and bring your set up-to-date with this new Karas achievement! Delivers correct voltage to the new AC Tubes 226 and 227. Does not permit excessive voltage and current fluctuations, insuring long life to your AC Tubes. Needs no separate device for center tap. Has plug-in connection for B Eliminator and loop of wire for connection to panel switch.

Type 12 supplies up to 8–226, 2–227, and 2–171 tubes.

8.75

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Write for details to

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TABLE TYPE CLAROSTAT

JUST the thing for the set! Micrometric resistance in convenient accessory form. No need for extensive changes. No need for tools. No need spending time and effort. Just connect in circuit by means of handy connection cords and connection block, and you have micrometric resistance at work improving your results. Ideal for volume control.

Finished in statuary bronze and nickel. Bakelite knob. Felt bottom. Two connection cords and tip connection block. Ample resistance range. Sufficient current-handling capacity. Resistance range in several turns of knob. Holds resistance setting. Foolproof. Durable. A *genuine* Clarostat, in a new dress. And all for $2.50.

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Ask your dealer to show you this and other Clarostats. And ask him for booklet "Radio Etiquette," or secure direct from us.

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Drilled and decorated for leading kit sets are available through leading jobbers everywhere.

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Broadcasting in Foreign Tongues

IN the September, 1927, issue of RADIO NEWS, one of our contributors, Charles Magee Adams, discussed the effect of radio broadcasting on American speech, and commented that foreign-language broadcasts in this country, save for a few elementary lessons, seemed unknown.

He was corrected by the sponsors of German broadcasting over station WIBO, Chicago, who had put on regular cultural programs on Sundays for those of German speech; but since that time "Mike" seems to have acquired the gift of tongues. Station WCDA, New York, devotes a considerable portion of its time to the exploitation of the melodious Italian language; and now WMBI, owned by the Moody Bible Institute of Chicago, has undertaken Scandinavian services on Saturday evenings and Tuesday afternoons, German services on Thursday afternoons, and Yiddish services on Friday evenings.

The European listener may acquire a radio familiarity with practically every language of the Continent, as he sweeps his dials from Moscow, Motala and Angora to Madrid, Paris, and Cork; perhaps the American will have an opportunity to cultivate the linguistic faculty hitherto so neglected in the United States.

Possibility of Receiving Europe

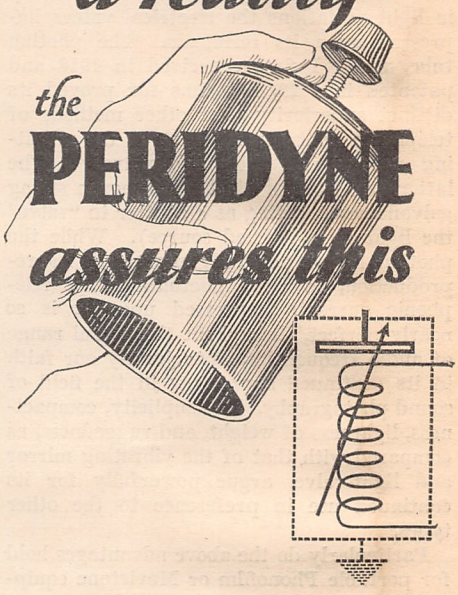
HAVING the advantage of the time difference, European fans hear American stations in the small hours, as Yankees hear the Pacific Coast. Recent reports indicate that on January 16 unusually good reception of American stations, even as far west as Oakland, was reported throughout England.

While the distance from the eastern United States to Europe is not so great as that from California to Japan, the American is handicapped by the fact that midnight in England, or 1:00 a. m. in Germany, is only seven o'clock in the evening in New York. For that reason transatlantic reception, though highly interesting, has never been practicable for many American listeners; especially as hitherto the highest powered stations of Europe have been out of the 200-600-meter band, requiring special coils in receivers tuned to them.

However, during the past year there has been a great increase in the number of super-power medium-wave stations in Europe; and it is quite possible that in good locations, free of other interference, some of these might be received early in the evening in parts of the United States.

Poland has opened a 10-kilowatt station at Katowice, operating on 422 meters. The short-wave transmitter of Daventry, England, 5GB, has been increased to 30 kilowatts, it is said; though unfortunately its wave is that of WEAF, 491 meters. Milan, Italy, has now much higher-powered equipment on 545 meters. Hungary has a "60-kilowatt" (25-kw. input) at Czepel in the Danube, near Budapest. And headlines announce that Zeesen, in Germany, is to be of higher power than the 100-kilowatt transmitter at Schenectady (something to be regarded with a grain of salt), and that "Radio-Paris" contemplates going this better, with a 150-kilowatt input.

An Efficient ONE DIAL RECEIVER *a reality*



the PERIDYNE *assures this*

THE PERIDYNE, due to the new principle on which its construction is based, assures positive true Interstage Resonance, and thus the perfect one-dial receiver has become a reality.

Distance, tone, remarkable performance under all circumstances—these are but a few of the remarkable accomplishments which can be had with the Peridyne.

Note the schematic symbol that had to be specially designed to designate the Peridyne character. No other symbol of this arrangement is provided in radio practice.

5 Full-sized blueprints and a 16-page instruction book.

Send today for the complete blueprints and constructional data for the Peridyne—only 50c. Build this set and prove to yourself its remarkable features and high efficiency.

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Gentlemen:
Enclosed find 50c., for which kindly send me a complete set of blueprints and full constructional data for the Peridyne.

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City.....State.....

What the Federal Radio Commission Needs

1275 Nelson Avenue
The Bronx, New York City.

Editor, RADIO NEWS:

This letter should interest you, because it has to do with a great invention which should revolutionize the radio industry, both commercially and scientifically.

Ever since radio became popular, I began to tinker and experiment with different kinds of hook-ups and devices for the improvement of radio. It got me like a cross-word puzzle. Once I began, I just had to finish. I spent almost as much money on triple bromides as I did for radio material. Edison paid large dividends last year because of me; because I stayed up every night, every night until early morn, until my eyes shut involuntarily.

But my efforts have not been in vain.

I have finally succeeded in inventing a device that will undoubtedly prove the biggest and most amazing radio feature since Marconi sent the first message through the ether.

My invention has been tried out in a practical way, and those few who witnessed the first exhibition marvelled at its wonders.

You will marvel too when I describe what this new invention can do. Remember, I have tried it out, and it worked.

Here's what this new device will do:

It will automatically stop any broadcast station from broadcasting, at the same time causing that same station to broadcast a program sent through my invention, but on the carrier wave of that station.

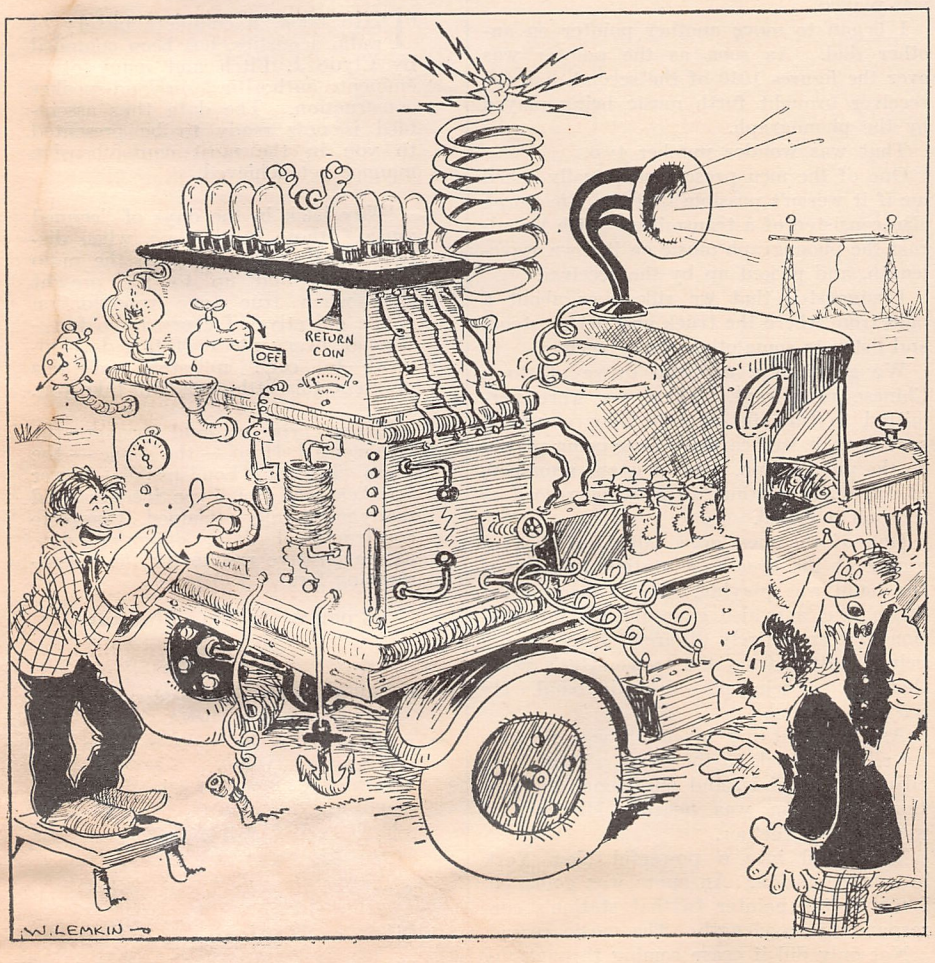
It will be impossible for any one to detect who has stopped the programs of the station, and unless that station shuts off its power, I will be able to send my own program on the station's carrier wave. I have done it, and it has proved entirely satisfactory.

It took me almost four years to perfect this device. Hard work and money borrowed from friends and relatives are responsible for its success.

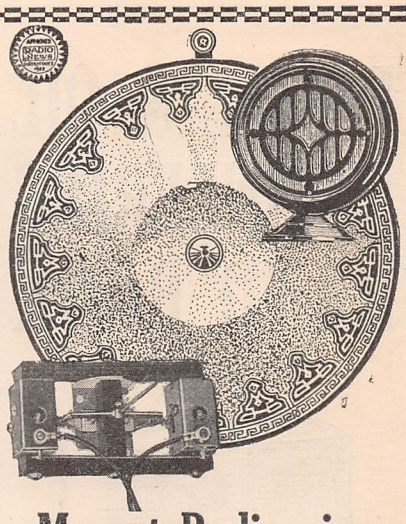
Two weeks ago I gave it a practical test at a radio broadcast station, located in New Jersey.

My device had to be delivered on a truck and had to remain on the truck as the machine, or *Vicograph* as I call it, weighs about one thousand pounds. The *Vicograph* is portable, especially so made on account of its necessity of being moved from place to place.

The machine consists of numerous coils, water jackets, water coolers, heavy cables, dry- and wet-cell batteries, tubes, dials, switches, and other accessories especially



"The shrill, whistling sound ceased, and all that was heard was the carrier wave; a sound similar to the one caused when steam escapes from a radiator."



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Speakers and Speaker Units
FOR SEASON 1928-9

FANS who know that the Loud Speaker Unit is the very heart of any Radio, are demanding better and better performance, hence the reason for the Radioceive Twin Balanced Armature, far outselling all others in this market.

Here indeed is true Push-Pull Tone Reproduction at a fraction of the cost it can be obtained in any other way, and with the very minimum of current consumption, and voltages ranging all the way from 90 to 400.

And for those who want a good cone unit at a lower figure, we offer our single balanced armature, which will outperform most others selling at twice its price.

Or in a complete speaker, our Mozart 26-in. Wall-Cone (not a kit) and Drum Type with these units, are guaranteed on a money-back basis to excell in appearance and performance all others in their class.

Single Unit, 5 ft. cord (1150 ohms)..... $4.00
Twin Unit, 10 ft. cord (2000 ohms)..... 6.00
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26-in. Wall Cone Speaker, Twin Unit..... 10.00
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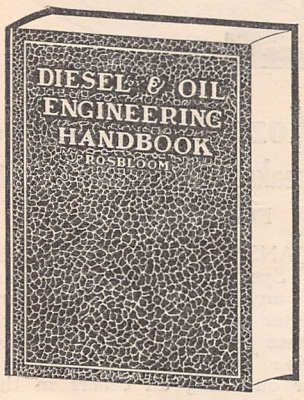

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designed for this particular device. They are too numerous to mention here.

I will now give you a description of what occurred at the New Jersey broadcast station when I made my first practical test.

The truck was placed about a hundred yards from the transmitter. The station began to broadcast a program of dance music played by a fourteen-piece orchestra.

The station used a frequency of about 1010 kilocycles. (I do not wish to mention the name or exact frequency of the station at the present time.)

The band got well on its way into the middle of its first selection, when I began to move a lever, slowly, to the point on a dial on the *Vicograph* where appeared the figures 1010. Through my receiver, which was part of the outfit, I could hear a whistling, shrill noise, becoming fainter and fainter, until the pointer on the dial was directly over 1010, the corresponding number of the transmitter's frequency. The shrill, whistling sound ceased, and all that was heard was the carrier wave; a sound similar to the one caused when steam escapes from a radiator.

That was wonder number one.

Of course, the staff of the station were aware of what was going on. I was doing all this with their permission, and they were truly amazed, bewildered, astonished, and puzzled. The six men, all radio engineers, stood there, open mouthed, open eyed. They were stunned.

I did not stop the experiment right there. I went on.

Included in the outfit was a small portable talking machine. This machine was mounted next to a microphone of my own design. I turned on the phonograph, and a record was played.

I began to move another pointer on another dial. As soon as the pointer was over the figures 1010 of the second dial, the receiver brought forth music being played by the phonograph.

That was wonder number two.

One of the men present skeptically asked me if it weren't possible that the *Vicograph* also consisted of a transmitter which broadcast the phonograph music on its own wavelength, and picked up by the receiver.

I suggested that we ride over about a mile from where the truck and device stood, and listen to some other radio receiver.

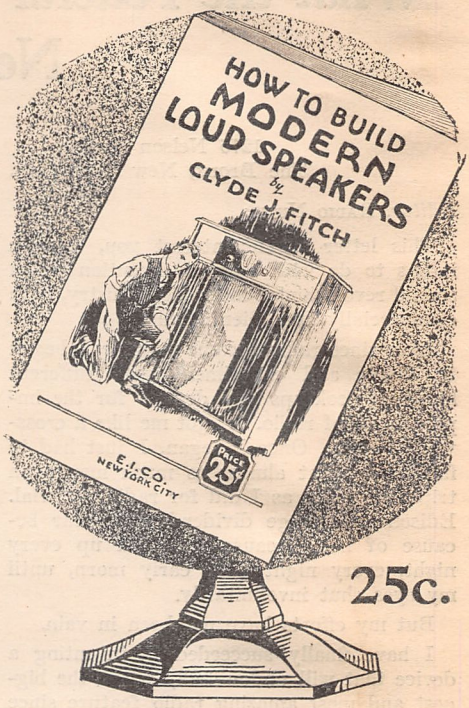
We got into a car and drove off to a Chinese restaurant. There we were permitted to tune in on 1010 kilocycles, and sure enough, we heard the song being played on the phonograph. My assistant remained, of course, to continue to play the record as soon as it ended.

One of the men even called up the engineer at the broadcast station to learn if the band was playing. He replied in the affirmative, and also gave out the information that an entirely different program was being emitted from the transmitter's radio than the one being played by the band. He too was puzzled.

Assured that my invention was perfect, we all went back to the truck. Then I readjusted the dials, and once more the station's program was heard. However, I went a step further.

We tuned into a powerful New York broadcast station. An opera was going on. I moved the pointer to that station's corresponding wavelength. The music ceased.

Not only did it cease coming through my receiver, but when we inquired whether the program was coming over the New Jersey



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transmitter's radio receiver, the operator told us no. We even tried out the receivers of some nearby dwellers, but there was no program heard. Only a carrier wave.

Some of the radio listeners thought their sets had gone wrong, or that an SOS was being relayed, or that the station had some technical trouble. But we let them know that we were doing this and that everything would be all right in a few minutes.

And everything was all right in a few minutes.

I tried the experiment on at least thirty stations, both nearby and distant, with the same results. We even phoned several of the local ones asking if they had any difficulty a few minutes ago, and they all informed us yes. Two told us that they had many phone calls advising them that their programs were discontinued, but that they could not understand the reason. They were puzzled.

I wasn't.

The other men and I went back to the transmitter, then to Newark, to the studio. There I was introduced to the real owners of the station.

Soon, several other prosperous looking men joined us.

The engineers explained the invention to the newcomers and for their benefit, I went through the experiments again. They were amazed like the first ones.

Before long, we began to talk about the commercial value of my amazing invention, and soon an offer was made me. I refused any offer. I told them so. But they insisted that I sell the invention. Of course, it was patented, and I had fifteen claims on various patents.

They took the initiative and offered me $250,000. I merely sat back and took another puff on my Lucky.

"Well, gentlemen," I said, "if I am going to sell, I wouldn't consider anything less than a million for the *Vicograph.*"

At that remark, several of the gentlemen got up and went into a conference in one of the corners of the spacious room. In a few minutes they returned to the table. One of the men stood up and said, "Sir, we have talked the matter over carefully, and upon careful consideration, we have decided to pay you the amount asked for—a million dollars."

Of course, I did not act surprised because I expected that amount. I knew that someone would pay it, and I considered this party of men fortunate in having obtained such a wonderful device, a device that will revolutionize radio.

One of the party took a small check book from his pocket, and with a quick stroke of his fountain pen, wrote out a check for one million dollars.

I took the check, shook hands with all the men around me—and then I woke up!

VICTOR W. COHEN.

THE DEPTH OF DEBILITY

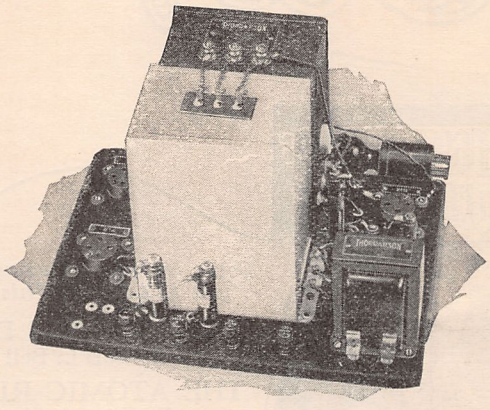
MRS. WILL DOOLITTLE: "My husband's so lazy he won't do nothin' but set to home and listen to the radio."

MRS. U. S. LESS: "Huh! My old man's so durned lazy he won't listen in unless I'm home to turn the dials for him."

ENOUGH TO RILE 'EM

It is said that both Dempsey and Tunney want to fight in England. We're not surprised, considering the dreadful radio pictures of the pugilists published in this country.—*London Opinion.*

for improved musical performance



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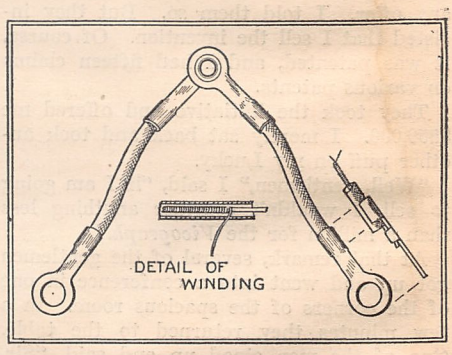
What's New in Radio

(*Continued from page* 1119)

the current flows through the battery in the correct direction. To do this, screw the connecting plug into the socket and turn on the switch; if the connections are correct the ammeter should read "charge." If the meter reads "discharge," remove the cap of the connecting plug (leaving the body in the lamp socket) turn the cap one-half turn (180°) and replace the cap in the body. The meter should now read "charge," indicating that the circuit connections are correct.

Center-Tapped Resistor For A. C. Tubes

Experimenters who are rewiring their old receivers for use with the new A.C. tubes and those who are building alternating-current-operated receivers will find great convenience in the use of a new type of center-tapped fixed resistor. The units are available in several resistance values, and so designed that they may be fastened directly to the filament terminals of any tube socket. One connected in this way provides an accurate electrical center for grid-return leads.



Drawing shows details of new "V" type center-tapped resistor unit. It consists of two units of fine resistance wire wound on an asbestos core.

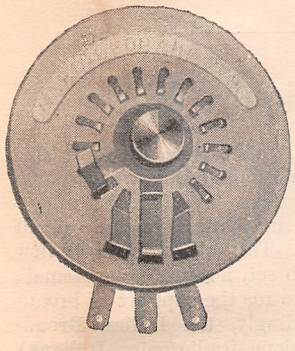
The illustration on this page shows the mechanical construction of the resistor unit. It consists of two wires fastened together at one end and forming a "V" shape, with soldering lugs attached to their other ends for making connections. Each wire is of identical construction and resistance, and consists of a core of asbestos cord on which has been wound a single layer of very fine resistance wire. The resistance wire is space-wound on the asbestos core, in order to give the unit a total resistance equal to that of the wire used; and each resistor unit is covered with spaghetti tubing for insulating purposes.

The resistance units described may be used in many different parts of A.C. receivers. They are available in eight sizes, ranging in resistance from 10 to 200 ohms, for connection directly across circuits having maximum working voltages of from 3.5 volts to 17 volts. For use in the filament circuit of 226- or 227-type tubes a 10-ohm unit should be used, in that of a 171-type tube a 20- or 30-ohm unit; and with a 210- or 280-type tube a 50-ohm unit is required. For circuits having higher voltages, the re-

sistance of the units employed should be increased in proportion.

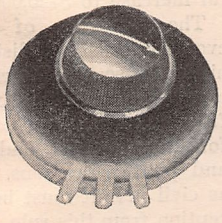
Two New Resisters Answer Power-Unit Needs

Two new resistance units, which answer the requirements of the builders of "B" socket-power units, have recently been put on the market; both will be found illustrated in these columns. One is an adjustable (tapped) resistor, designed especially for providing a voltage drop to be used in biasing the grids of amplifier tubes; and the second is a rheostat potentiometer in different values, for which there are many applications in the voltage-dividing circuits of power units.



Rear view of high-resistance rheostat shows method of making adjustment with contact arm. The units are variable in 16 steps, and may be connected as either potentiometers or rheostats.

Both the tapped resistor and the rheostat are made by winding a special wire whose resistance changes little with the heat, on a tube or base which is very heat-resistant, and coating the entire surface of the unit with a glass-like enamel. The enamel is applied by a method which is largely responsible for the long life and permanent accuracy of units of this type; it covers the entire surface of the resistor and, in a firing process, is intimately bonded with the surface of the resistance wire. The heat developed under the load, when the resistor is used, is instantly transmitted to the enamel and from the enamel to the air. Heating and cooling do not affect either the wire, the enamel, the refractory tube or base; as they all expand and contract alike. Also, the total resistance of the unit remains practically constant, regardless of the temperature. Therefore, these units are excellently suited to the requirements of the radio power units.



The high-resistance rheostat-potentiometer is designed for one-hole mounting, and is adjusted by a small knob located on the front of the panel.

The tapped fixed resistor has a total resistance of 375 ohms and is capable of dissipating 12 watts. It is equipped with three taps and the arrangement is such that it is possible to obtain 15 different resistance

This tapped resistor may be used to obtain grid bias for power tubes, when a socket-power unit is used.

Of Course!

You know that this is not a modification of existing obsolete circuits.

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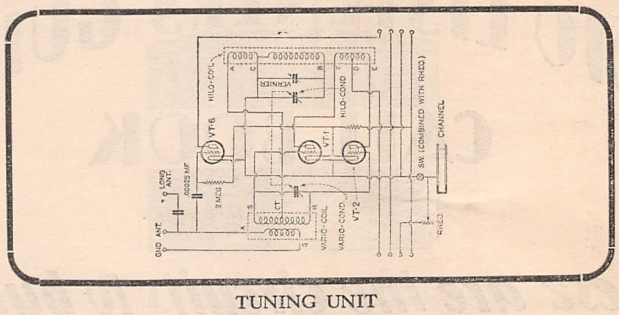

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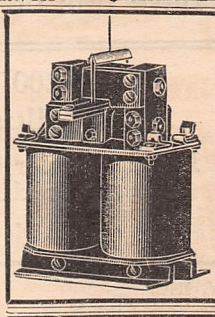

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See page 1176

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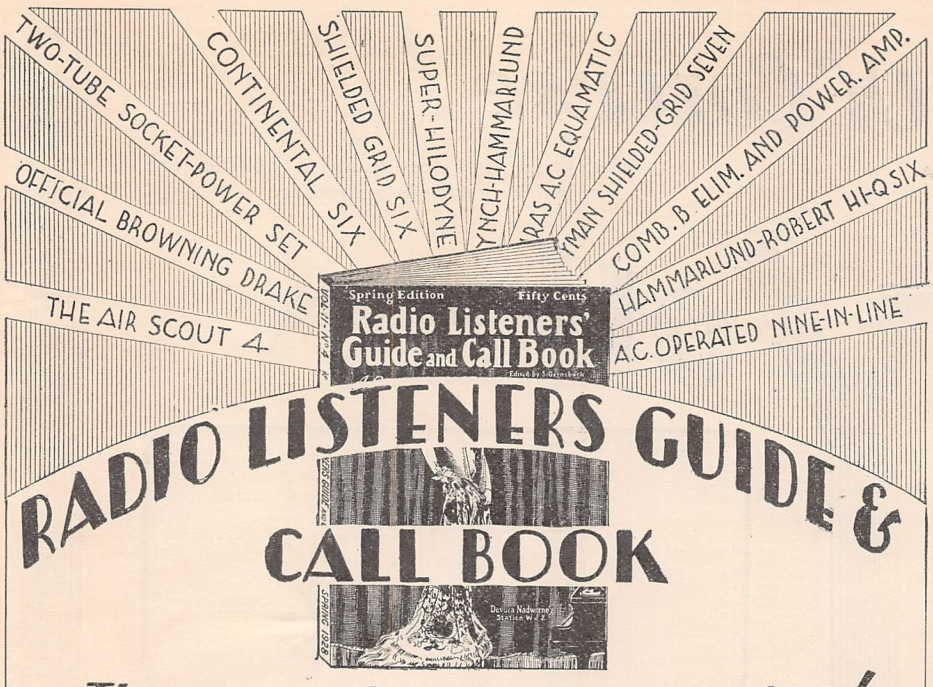

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values between 25 and 375 ohms. The unit is four inches long, approximately ⅝-inch in diameter, and provided with five soldering lugs for terminals. It will pass a current of 300 milliamperes and may be used in any "B" socket-power unit without danger of burning out. It is especially intended for use in circuits where the entire plate and shunt-resistor load of the socket-power unit passes through the grid-bias-voltage resistor.

The rheostat illustrated is made in thirteen different values, ranging in resistance from 1 to 50,000 ohms. Each type is of identical construction, and is capable of dissipating 20 watts when mounted inside a cabinet or 25 watts when exposed to the air. The unit is provided with 16 steps, and its slider is adjusted with a bakelite knob; three terminals are provided, so that it may be connected as a potentiometer if desired.

Radio in Italy

WHILE in America, we are told, it is up to the radio manufacturers to help out the broadcasters, in Italy the broadcasters are anxious to promote the sale of radio apparatus. This is because every new owner of a radio set, no matter how small, pays a license fee for the support of broadcasting. Accordingly, the Italian Broadcasting Co. (Unione Radiofonica Italiana) has announced a prize of 40,000 lire (about $2,100) for the best new set design, presented by an Italian manufacturer, of a set capable of bringing in all the Italian stations on the loud speaker, as well as adapted to mass production. A quarter of this sum will be awarded as a prize for the best home-built set, and an exposition of the entries will be held. The company has been reorganized as the "E.I.A.R.," with a capital increase to $420,000.

The possession of radio receiving sets, even for broadcast listening, has been prohibited in several districts, such as the cities of Fiume and Zara, near the Jugoslavian frontier. This is an extension of the former forbidden district, and is made for military and political reasons. A military as well as civil permit must be obtained for an exception from this rule. In addition, a group of patents obtained by Manrico Compare for radio inventions have been "expropriated" by the Italian government for purposes of national defense. They include combination telegraphic instruments for radio or land-line use, which may be used with a form of typewriter.—*E. Z.*

Care of Electrolytes

IN order to obtain long life and satisfactory service from rectifiers and condensers of the electrolytic type it is essential that nothing but pure distilled water be added to the electrolyte. This rule is just as essential in the operation of electrolytic cells as in the case of storage batteries; for, if city water from the pipes in the house is used, the mineral contents may cause a chemical action which will destroy the efficiency of the unit. If the electrolyte of a cell is evaporating too rapidly, it is possible to correct this by adding a small quantity of thin mineral oil; this will form a film which retards evaporation.

The Listener Speaks

(*Continued from page* 1104)

During the period of this flight, the writer was at Belle Isle Station, which is situated on a rock 9½ miles long, and 3 miles wide, lying between Newfoundland and Labrador, at the entrance of Belle Isle Straits, where the Canadian Government has established a fully-equipped high-power commercial and radio direction-finding station.

When Commander Byrd flew in the plane "Miss America" from New York to Paris, the writer was on duty up to midnight, and took several radio bearings on the signals emitted by his radio apparatus (call WTW) so that if, by chance, he had fallen into the sea we could have plotted his position fairly accurately. The signals of his automatic transmitter came in very loud and clear until he was more than half-way across, and could even be heard until daylight intervened. I mention this as an example of the value of adequate radio apparatus on these transatlantic flights.

Now the point is, why is radio not used more extensively in planes on transatlantic flights, and also why don't these ships of the air carry experienced and competent radiomen, who are well versed in the handling of radio traffic, instead of men who can barely receive 5 words per minute, and whose knowledge of radio traffic regulations is practically nil?

I have heard repeated efforts of experienced men on passenger vessels endeavouring to work these planes, and either due to the inefficiency of the receiving apparatus, or the inefficiency of the operator on the plane, extraordinary difficulty was encountered in the exchange of radio traffic. It is a well-known fact among commercial operators that one or both should be improved.

I would advocate the passage of a law, if necessary, to make these planes conform to the radio laws of the United States, and carry adequate radio apparatus, and competent radio operators, similar to the ocean-going steamships.

This would not only ensure the safety of life, but would be the means of saving the U. S. Government, and other governments thousands of dollars which have been spent, and which will continue to be expended in fruitless search for lost planes, which can only be likened to "hunting a needle in a haystack."

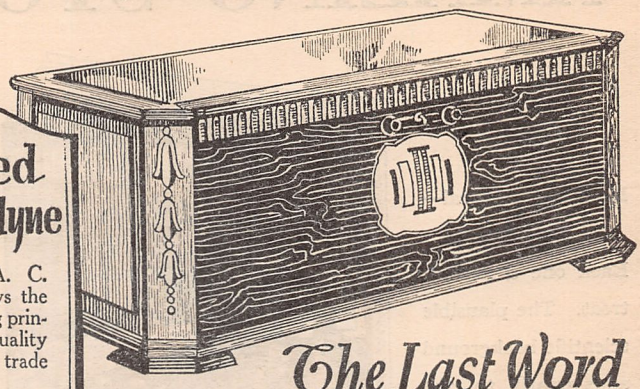
M. C. Wilson,
(Radio Operator)
77 Warren Avenue.
Boston, Mass.

(While radio might not ensure the safety of flight in planes incapable of sustaining themselves even temporarily in case of a forced landing, it would lessen the uncertainty which at present exists as to the fate of many aerial expeditions. In France, where commercial flight is more common, radio equipment on passenger planes is required by law.—Editor.)

Editor, Radio News:

I live 150 miles north and a little west of Minneapolis and WCCO is our "local" station. While listening to a national-interest speech, such as the president's address, I have many times turned to WOC,

ULTRADYNE A.C. COMMANDER



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Davenport, or WHO, Des Moines, Iowa, 275 miles away, or WOW, Omaha, 335 miles, receiving the speech with equal clearness and volume. The larger Chicago stations, 400 miles, are received consistently with good clarity and volume. WWJ, Detroit, 542 miles, is usually available, and WTAM, Cincinnati, 700 miles, comes in good but not regular; some days it cannot be heard. WJZ and WEAF, 1019 miles, and KDKA, 850 miles, come in consistently, with good clearness and volume, any afternoon when there isn't an electric storm. For some reason we cannot get KOA, Denver, 800 miles, with sufficient volume in the daytime; though at night it roars like a 50,000 watter.

The above is loud-speaker work; I haven't used the headphones on this set since testing after building. It contains only seven tubes with two stages of intermediate frequency. My advice to Mr. Woodruff would be to either get a *real* superhet or move out of the dead area. Or is Mayor Thompson causing too much disturbance with his campaign against the missing "haiches?"

Seriously speaking, there must be a large absorption of radio waves in a large city like Chicago. I know that interference is terrible compared to out here in the large open spaces. I had my superhet in Minneapolis where it seemed to have equal reach, but a whale of a difference in noise pickup. When the static season comes around, and this seems to be one of its favorite spots, for pleasurable radio entertainment we are confined almost entirely to daylight reception and would certainly be highly disappointed if we could not reach out.

M. P. Masseure,
Aitkin, Minn.

(The number of letters that Mr. Woodruff's inquiry has elicited is enormous, and it is evident that there is much interest in daylight broadcasting. Many stations have been authorized to use much higher power in the hours before 7 p. m., and do so; this compensates to some extent for the greater dissipation of radio waves in sunlit atmosphere. Incidentally, it must be remembered in all comparison of DX records that, while a good receiver has much to do with them, a favorable location is also a most important factor.—Editor.)

Use of Long Aerial

Editor, Radio News:

With reference to Mr. Woodruff's letter, the writer recently installed a "Silver Ghost" receiver at the home of D. G. Haley, Terra Ceia, Florida, and perfect daylight reception was obtained from Fort Worth, Texas, and Shreveport, Louisiana, at noon. During the broadcasting of President Coolidge's speech from Havana, WJZ and WEAF were clearly heard at 10 and 11 in the morning. From 4 p. m. on, programs can be received from all over the United States with great loud-speaker intensity. It must be remembered that the temperature at Terra Ceia runs around 80 in the daytime.

Daylight reception is greatly assisted by the use of an efficient antenna. At Terra Ceia we used a 600-foot single wire, 50 feet high and running east and west. A separate aerial is used for north-and-south reception.

C. R. Leutz,
President, C. R. Leutz, Inc.,
195 *Park Place, Astoria, L. I., N. Y.*

A Simple Test Device

WHEN a radio set "goes dead" it is often very difficult to determine the exact location of the trouble; though frequently, however, it will be found that one of the tubes of the set is not receiving plate current. When such trouble is experienced a small magnetic compass may sometimes be used to locate the defective circuit. Turn the set on, place the compass in or near the coil or the transformer which is connected in the *plate* circuit of one of the tubes of the set, and then remove the tube from the socket. If the needle of the compass moves when the tube is removed from the socket, it indicates that a current was flowing in the circuit. The experiment should be repeated with each tube until the faulty circuit is discovered. It should be remembered, however, that in the case of audio transformers which are shielded by grounded cases the compass will be unable to detect the flow of current. It is not suitable, however, for current measurements; a reliable milliammeter should be used for this purpose.

The Community Aerial

IN Gothenburg, Sweden, a new solution for the apartment-house aerial problem has been found, by the suspension of a metal ring in the courtyard of a multiple dwelling. It is held tightly by steel wires; and the radio aerials, to the number of fifty, are attached to it—by insulators of course—and to the tops of the neighboring roofs. Each is of the T-type, with a lead-in from the center; and the assembly is said to resemble a gigantic spiderweb. A charge of about $4.00 is made for connection to this system. Incidentally, it may be said that the European custom of depending upon one station for entertainment, as only the local can be received consistently with crystal sets, probably makes for less interference than would be thus caused in an American apartment neighborhood.

Radio Term Illustrated

"INTERFERENCE"

—*The Listener-In, Melbourne.*

Indian Program Numbers

FEW American listeners have as yet even imagined that they have received the new high-power stations at Bombay and Calcutta, India. However, the novelty-seekers who are dissatisfied with the monotony of our own programs have a mark to shoot at. We take a few items from a recent schedule of 7BY, Bombay, which appears in a late issue of the *Indian Radio Times,* with which a correspondent kindly supplies us:

"Ustad Hanuman Parshad of Jaipur. Vocal music in Purvi, Nat, Behag and Kamod Ragas.

"Walwalkar of Balgandhary Natak Mandali. Dramatic songs.

"Gopaldas Purshottamdas. Vocal music in Bageshree and Yamankalyan Ragas and a Tumri.

"Balakrishna Buwa. Vocal music in Rageshree, Latat, and Tilak Kamod Ragas and a Tumri.

"Jayaram Achrekar. Vocal music.

"God save the King-Emperor. Close down."

Now Broadcasting Checks

CHESS is said to be the oldest of games —as its partisans conveniently overlook the claims of dice; it is also popularly reputed, among those less familiar with it, to be the slowest-moving. This may account for the fact that it has not been broadcast by radio until lately. The chess fans of St. Louis have shown some more of the spirit which made that city famous; and chess talks are now featured weekly on Tuesday afternoons, by KMOX of that city. We do not understand that there is a popular demand sufficient, as yet, to put them on the chain programs beside bridge.

MODERN MARY

Our Mary's bought a Superhet—
My WORD, it is a WOW!
Most any station it WIL get;
'Twill WALK them in, and how!

Poor Mary sold her lamb and KOW
To KICK in with the KOIN,
But said, "It's worth it, don't you see,
The BCLs to join."

Her erstwhile peaceful cottage
Is now the scene of WARS;
The family for the locals WAIT,
While Mary will WOO Mars.

Father says, "Now KUT it out!"
He's a perfect WREC, you know:
For WATT little sleep her poor Dad gets
Is WHN the batteries are 2LO.

—*Joseph W. Sine.*

RIGHTEOUS RETRIBUTION

The Queen of Hearts,
She made some tarts
From a radio recipe;
The Knave of Hearts,
He stole those tarts
And suffered perceptibly.

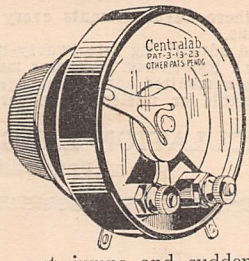
—*Popular Radio Weekly,* Australia.
(Original source not given.)

THE SPRATTS

Jack Spratt liked Mike and Pat,
His wife liked String Quartets;
And so betwixt them both, you see,
They had two radio sets.

—F. P. A., in *New York World.*

A New and Improved Volume Control for "AC" Circuits



Centralab Radiohms RX-100 and RX - 025 have been built with exact taper of resistance to give effectual control of volume smoothly, without jumps and sudden blasts.

When the RX-100 is placed across the secondary of one of the R. F. stages it surely and positively controls the volume from a whisper to maximum on all signals —powerful locals notwithstanding. This Radiohm will also control oscillation very effectively.

The RX-025 has the exact taper of resistance for a volume control when placed in the antenna circuit, or across the primary of an R. F. transformer.

One of these two Radiohms and the Centralab Power Rheostat are essential resistances for all "AC" circuits. They help to maintain the delicate balance of voltages throughout the circuit and in no way affect the balance between plate and filament current, so necessary to maximum efficiency.

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Brand New Idea for a Radio Party
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Just Plug in Set
Be Your Own Broadcaster

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Objectionable or misleading advertisements not accepted. Advertisements for the June issue must reach us not later than April 1st.

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Inventions Commercialized. Patented or Unpatented. Write Adam Fisher Mfg. Co., 278 Enright St., St. Louis, Mo.

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Miscellaneous

Inventions Commercialized. Patented or Unpatented. Write Adam Fisher Mfg. Co., 278 Enright, St. Louis, Mo.

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Send us your portrait and we will enlarge it for $5.00. Ben Griep, Carthage, Mo.

Transformer forms turned from wood. 25c each. Send sketch. Mabry Radio Shop, Beaumont, Texas, 1912 Hazel.

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Musical

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Old Coins

Old Coins. Large Spring selling catalogue of coins for sale, free. Catalogue quoting prices paid for coins, 10c. William Hesslein, 101 K, Tremont St., Boston, Mass.

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Old Money Wanted. Will pay $100.00 for 1894 Dime, S. Mint; $50.00 for 1913 Liberty Head Nickel (not Buffalo). Big premiums paid for all rare coins. Send 4c for Large Coin Folder. May mean much profit to you. Numismatic Co., Dept. 112, Ft. Worth, Tex.

Patent Attorneys

Patents—Send for form "Evidence of Conception" to be signed and witnessed. Form, fee schedule, information free. Lancaster and Allwine, Registered Patent Attorneys in United States and Canada, 269 Ouray Bldg., Washington, D. C.

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Inventors—Should write for our Guide Book, "How to Obtain a Patent" and Record of Invention Blank, sent free. Send model or sketch of inventions for our Inspection and Instructions Free. Radio, Electrical, Chemical, Mechanical and Trademark Experts. Terms Reasonable. Victor J. Evans & Co., 922 Ninth, Washington, D. C.

Patent Sense—Valuable book free. See Lacey's ad, page 1181. Lacey & Lacey, 631 F. St., Washington, D. C. Established 1869.

Wanted, Ideas. Demand for novel devices, however small. If patentable, may be the means of your independence. Patents obtained. Sales negotiated. Advice free. INVENTORS SERVICE BUREAU, Box 1648, Washington, D. C.

Patents

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Radio

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100-volt Edison element rechargeable "B" battery kit $8.00. 140-volt, $11.00. 180-volt, $14.00. "B" Charger $2.00. Edison elements with welded connectors 5c pair. Send for list. Zied, 834 North Randolph, Philadelphia, Pa.

Transformers 650-7¼, $5.50. 550-5, $4.00. Knock-down primary only $3.00. Write for lists. Radio Parts Sales Co., Orange, N. J.

Write about our efficient power devices. KIMLEY ELECTRIC CO., 441 E. Ferry, Buffalo, N. Y.

Edison Element "B" Batteries. Prices reduced. 100 volts complete, $9.50. Trickle Battery Chargers, $1.75. 6-volt 100-ampere Batteries, $6.89. Motors, ¼-horsepower, $7.00. Hoffman, 824 North Fifth, Philadelphia, Penn.

To highest bidders—Radiola Superheterodyne and Western Electric Power Amplifier. Write, Leslie Frazer, Ivor, Virginia.

Wanted: Men to work with National Radio Service Organization. No selling scheme. Co-operative Radio Doctors, Dept. N, 131 Essex St., Salem, Mass.

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A paying position open to representative of character. Take orders shoes, hosiery, direct to wearer. Good income. Permanent. Write now for free book, "Getting Ahead." Tanners Shoe Mfg. Co., 874 So. C. St., Boston, Mass.

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Full Value Paid for Old Gold, Jewelry, Watches, Diamonds, crowns, bridges, dental gold, silver, platinum, gold or silver ore; magneto points, old false teeth. Packages returned if our offer is not satisfactory. United States Smelting Works (The Old Reliable), 39 So. State St., Dept. 16, Chicago, Ill.

Set Constructors' Letters

(*Continued from page* 1147)

and help. Please be so good as to publish this, as I am almost inundated.

Of all these letters which I have received, only a comparatively small number enclosed a stamp for reply. Those who did not I have not answered; as I had to draw the line somewhere. I am not a Member of Parliament or a Congressman, consequently I can not send my correspondence "franked."

Let me say to those asked for information and plans that they will find complete information in Radio News for October, 1927, or Radio News Blueprint No. 31. I have done considerable experimenting with the hook-up and made certain changes which, in my opinion, are improvements. If any of your readers desire this information it may be obtained if they will send a dime for same; no attention will be paid to letters otherwise.

Many correspondents report great difficulty with distortion. Let me say that I have the same trouble here; while a friend using a Short-Wave receiver about a mile from me gets the Short-Wave broadcasts with perfect clarity. The answer is, evidently, location. There is no remedy known except to move!

I might mention that 5SW at Chelmsford, England is now on a regular schedule from 7 to 8 a.m., and 2 to 5 p.m., E. S. T., daily except Saturday and Sunday. The broadcast is by remote control from 2LO at London; announcements are very infrequent. The wavelength is 24 meters.

Carl W. Beese,
146 *Market Street, Hamilton, Ontario, Canada.*

(Mr. Beese's offer is so plainly not intended for profit, that it is given here; though this department is obviously not a medium for the sale of information and diagrams. The good nature of an experimenter who is willing to impart information as to his results should not be imposed upon by the merely-curious, and correspondents should bear in mind that they may number hundreds. Incidentally we may say that the October, 1927, issue of Radio News *has been exhausted, proving the interest of our readers in short-wave reception. For that reason an excellent model, which should prove equally serviceable, is described at length in this issue of* Radio News. *We shall be glad to hear of the results obtained.*—Editor.)

AN UMBRELLA AERIAL

Editor, Radio News:

I am enclosing a picture of my residence, showing a type of aerial which can be installed conveniently where there is no room to string a long wire. I have copied very good distance; received KFI on this aerial. It contains over two hundred feet of wire. (See page 1147 for picture.)

Harold H. Hurley,
Box 355, Lake Como, New Jersey.

(Under conditions such as those described, it is possible to put up a system of this kind, with considerable signal-collecting capacity, in a small area. The length given, however, is rather too much for selectivity with an ordinary receiver. —Editor.)

THAT SIBERIAN TRANSMITTER

Editor, Radio News:

I have heard the announcer of the Siberian short-wave station at Khabarovsk giving call of RSN and his wavelength in English last night. He gave it as 56 meters. This comes in on my set, which is fully shielded, at about 44 on the dials with a 12-turn coil; and KDKA at 54. I have heard G2NB and PCJJ and one Japanese; others too weak.

C. A. Blackington,
Wrangell, Alaska.

(A Japanese friend, Mr. N. Miyake, favors us with a news dispatch indicating that "'RFM,' operating on 60.12 meters, has been heard quite distinctly in Japan every night from about 7 to 9 p. m." This is from 5 to 7 a. m., U. S. Eastern Standard Time. It is quite possible that this 20-kilowatt phone station has been roving the short-wave band.—Editor.)

MORE WORK ON THE PERIDYNE

Editor, Radio News:

In answer to your request for letters from builders of the Peridyne, here is mine, with very many thanks for the guidance in setting it up, as well as the good results. I had great faith in its possibilities of reception and performance, the first time I saw the hook-up, but it has really passed my expectations.

The first night, KFI and other distant stations galore. I was listening to KFI this morning from 12:30 to 1:30, very clear and distinct, no fading—just a little "steaming" one gets occasionally when tuned to a distant station. There is great interest being taken in it locally; but it gave me a thrill when it performed so faithfully at first.

I use two aerials: one in the basement of 35 feet, and an outside one of 120 feet (too long). The inside one gives me as far as Kansas City or Lincoln, Neb., etc. But the reproduction! It is simply wonderful.

Leonard F. Scott,
670 *Jane Street, Toronto, Canada.*

I Want To Know

(*Continued from page* 1152)

There is still another type of electrolytic rectifier which is very efficient. This consists of a tantalum plate and a lead plate in a solution of sulphuric acid and distilled water; this solution should have approximately the same specific gravity as that used in storage batteries. The advantage of this type of rectifier is that the tantalum does not corrode as quickly as the aluminum, and naturally the electrodes last longer. Another advantage is that this type of electrolytic rectifier does not heat up as quickly as the other.

AN ACKNOWLEDGMENT

The data which form the answer to question number 2265, printed in the "I Want to Know" department of Radio News *for February,* 1928, *were taken from the* Radio Broadcast *Laboratory Information Sheets (Nos.* 27, 28 *and* 65), *and should have been credited to that source. Acknowledgment is made herewith to* Radio Broadcast Magazine *for the valuable information.*

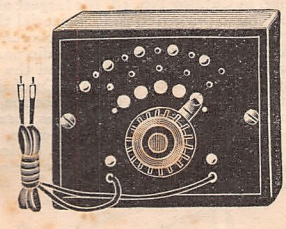
Radio News Laboratories

(*Continued from page* 1149)

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2290.

MULTIPLE SPEAKER SWITCH

The demonstrating unit shown is a very practical switching device which allows comparison of various loud speakers and phones. It consists of a small neat wooden box, 4½ x 3⅝ x 5⅛ inches, carrying a small bakelite panel 4½ x 3⅛ inches. On this panel are mounted a switch and five contact points, and in it are drilled six pairs of holes to fit standard phone tips. Five pairs of tips are for the instruments to be tested, and one for the output leads



from the receiver. Inside the box, ten springs which make contact with the phone tips are arranged in two rows; those in the first are electrically connected together and to the corresponding contact springs of the incoming lead. The other five springs are connected, each to a contact point, and the second input lead through its contact spring is connected to the switch. The operation of this switch is very satisfactory.

AWARDED THE RADIO NEWS LABORATORIES CERTIFICATE OF MERIT NO. 2291.

FERBEND LEADS AGAIN!

NOW!—Lowest-Priced Quality Tube "B" Eliminator - - - - $18.50

Since 1921 Ferbend Products have been famous for outstanding quality and long-life efficiency at lowest prices—prices "Within Reach of All."

The new HEAVY DUTY "B" Power Unit is no exception. In workmanship, performance, materials and appearance it is the equal of any. We INVITE comparison.

SEE YOUR DEALER, OR SEND DIRECT

Shipment will be made upon receipt of price or C. O. D. Use for thirty days to convince yourself—then if not satisfied write us within that time and purchase price will be refunded. Order today.

Complete,
Including
Long Life Perfected 85 MIL. TUBE
Delivers up to 180 volts on any set
NO LIQUIDS OR ACIDS
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425 WEST SUPERIOR STREET CHICAGO, ILL.

YAXLEY
No. 440 Full Automatic
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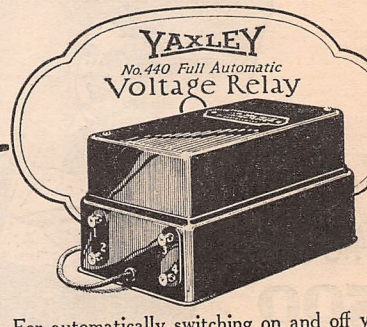

For automatically switching on and off your B Eliminator and Charger, or either, and in addition, automatically *switching off your Charger when the battery is fully charged.*

With the Full Automatic Voltage Relay it is now practical to utilize the advantages of a high rate charger and at the same time control the switching of the charger as well as the B Eliminator with the switch or filament control on the set.

No. 440 ..... $7.50

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We are the oldest established, exclusive radio mail order house in the country. All orders are positively shipped within twenty-four hours; quick, prompt, courteous service. We carry a larger variety of radio parts, radio instruments, accessories and radio findings than any other radio house in the country.

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You will find in Catalog No. 18 the largest assortment of radio merchandise in this country. Radio Specialty carries more radio parts and radio material than any other house in the country. You will find in this catalog positively the largest variety of radio merchandise.

If you are in need of certain small radio parts that other radio and mail order houses do not bother to carry, get the Rasco Catalog and you will find the small parts there, anything from a screw to copper ribbon, telephone diaphragms, as well as thousands of other small radio findings. Just to mention a few:

Lugs, nuts, jacks, plugs, all kinds of knobs, cords, panels, screws, sliders, washers, selenium, tinfoil, switches, crystals, cap nuts, Litz wire, cord tips, brass rods, resistances, binding posts, switch parts, carbon balls, switch points, lock washers, carbon grains, ground clamps, metal pointers, insulated tubing, low melting metal, antenna connectors, as well as thousands of other articles. *We carry the Largest Variety of Small Radio Parts in the World, BUT We also carry All Standard Radio Merchandise*

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98 W PARK PLACE NEW YORK

For use on
110-120 Volt A. C. Lines

ONLY $12.45 Direct from factory TO YOU!

The MOST Sensational "B" Eliminator Announcement *ever* Made!

Now—you can buy as good a "B" Eliminator as is possible to build—at a price that won't cramp your purse. Now—you can enjoy the thrill of louder, clearer, better reception that a good "B" Eliminator affords. And you buy the PEERLESS without risk of any kind, for it is backed with a

2 Year Guarantee

This astounding offer is without a precedent. Never before has such a value been offered. A "180" volt "B"—a "B" that will run your set and a power tube too—and guaranteed for two long years—at the ridiculously low price of only $12.45.

Uses
85 MIL. TUBE
Delivers

180 VOLTS

The PEERLESS is small, thin and compact. Slides into small spaces, table type cabinets, etc. Case is heavy steel, maroon crackle finish. Comes complete with cord and separable plug.

Because of its very low price, don't confuse the PEERLESS with Eliminators which deliver only 90 or 100 volts. Also, don't confuse it with chemical type Eliminators. The PEERLESS uses the standard 85 milliampere gas-filled Raytheon or Q. R. S. rectifying tube. It is dry. No water, no acids to add. Requires no attention whatever. Delivers pure, hum-free "B" current of 22½—45—90—135 and 180 volts. Out-put Voltage taps are fixed. No adjustments. Will run *any* set. Will operate any power tube requiring no more than 180 volts. Will not "motor-boat" on superheterodyne receivers. Operates resistance-coupled audio amplifiers, when other "B" Eliminators fail. In every sense of the word, the PEERLESS provides the finest kind of "B" Eliminator performance—at only $12.45. Why pay more?

TUBE FREE

SPECIAL INTRODUCTORY OFFER

This is the first announcement of this new, super-powered, better quality guaranteed "B" Eliminator. Its regular price is $12.45 without the rectifying tube. But, as a special introductory offer to get thousands of these units out on sets, we will include, for a limited time only, a genuine $4.50 Q. R. S. 85 Mil. Tube free with your order. Think of it! A 180 Volt "B"—a 2 year guarantee—the privilege of trying it 30 days at our risk—and a $4.50 tube free—all for $12.45. Mail coupon now.

30 DAY TRIAL

Read all about this great new, better, tube type "B" Eliminator in the left column of this page. Then order it at once. Hook the PEERLESS up to your set. Compare the reception you get to that which you got before, or to that which you can get from any other "B" Eliminator. Put the PEERLESS to every test you can. Make it drive a "171" power tube, if that's the tube you use in your set. Enjoy this "B" for 30 days. Then—send it back, if you think that any other "B"—at any price is as good. We'll refund your money instantly.

$1 **DOWN** Mail Coupon TODAY

Send only $1. A dollar bill will do. We'll ship the PEERLESS "B" Eliminator at once. Pay the expressman $11.45 plus small express charges. Remember—you order the PEERLESS entirely at our risk. It is yours to test for 30 days. You get your money back promptly if within that time, for any reason whatever, you don't want to keep the PEERLESS. Order now. Fill in the coupon and mail today.

PEERLESS MFG. CO.
3977 Cottage Grove Avenue
Chicago, Ill.

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3977 Cottage Grove Ave., Chicago, Ill.
I enclose $1. Send me the 2 YEAR GUARANTEED PEERLESS "B" Eliminator and free 85 Mil. tube for 30 days trial. I agree to pay expressman $11.45 plus express charges.

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(State) _____

Only 4.87 FOR THIS REGULAR $12

A-C Filament Supply TRANSFORMER

Now—at a reasonable cost—you can build a set using A-C tubes, or convert your present set into an A-C set. This new, advanced type, better quality, heavy duty A-C filament supply transformer is now available to you at the very low price of only $4.87—instead of the $12.00 price at which it has always sold. You can't buy the equal of this transformer any place for less than $12.00 or $14.00. Why pay more than $4.87, when this unit is fully

GUARANTEED

Guaranteed to deliver the correct voltages at the taps as marked—Guaranteed against def ct in material and workmanship—Guaranteed the best performing A-C filament supply transformer built.

TRY IT FREE

Test This Unit at Our Risk

Order it. Connect up to your set. Check the voltages with an accurate voltmeter, if you like. Put it to any test you wish. If you think, for any reason at all, that this unit is not the best A-C filament transformer you can buy, send it back and your money will be refunded to you *instantly*. You are the sole judge. Order NOW. Attach dollar bill to the coupon and mail right now. Pay postman $3.87 plus few cents postage when the transformer arrives. Then, make your tests. Remember—you take no risk. Guarantee protects you. Clip coupon. Order today.

LOOP for SWITCH

The loop of wire shown in back of the transformer case is an extension of one side of the 110 volt line. It is provided for the convenience of those who wish to cut in a power switch to be mounted on the panel of the set.

Supplies Proper Voltages for All 226, 227 and 171 Tubes

With this A-C Filament Supply Transformer you can operate a set combining 6 type 226 A-C tubes, 2 type 227 tubes and 2 type 171 power tubes. Hence, the most elaborate super-heterodyne receiver may be operated with this unit. Each of the three secondaries are center tapped, thereby doing away with the need for center-tap resistances required by other types of filament transformers. Don't confuse the Illinois A-C Filament Transformer with others which supply only five and six tube sets.

Works Perfectly With the New A-C Harnesses

Use the Illinois A-C Filament Transformer with the new A-C conversion harnesses. Convert any battery operated set into an A-C set in a few minutes' time. Enjoy the freedom from "A" battery nuisance which these new harnesses and the Illinois A-C Filament Transformer makes possible. Order one of these guaranteed units today. Take advantage of the low $4.87 price.

$1 DOWN

The Famous ILLINOIS "All-Frequency" AUDIO TRANSFORMERS

LIMITED OFFER **97c Each**

This is the most amazing radio value ever offered. Think of it! A $4.00 audio transformer—a real "all frequency" unit of the finest musical capability, offered direct from the factory for only 97c. Never before such a bargain opportunity. Thousands have bought them. Sold with a positive guarantee of satisfaction or money back. Supplied in ratios of 1½ to 1, 3 to 1 and 5 to 1. Order now. Use coupon.

ILLINOIS TRANSFORMER CO.

223 W. Elm St. Dept. 101 Chicago, Ill.

MAIL THIS COUPON

ILLINOIS TRANSFORMER CO., Dept. 101
223 W. Elm St., Chicago, Ill.

☐ I enclose $1.00. Please ship me one Illinois A-C Filament Transformer for 226, 227 and 171 standard tubes. I agree to pay postman $3.87 balance and small postage. It is understood that I can have my money back if not satisfied.

☐ I enclose $..... Ship me the following Illinois Audio Frequency Transformers: .....1½ to 1; .....3 to 1; .....5 to 1. I understand I can have my money back if not satisfied.

Name .....

Street .....

Town .....*State* .....